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NUCLEAR SCIENCE ABSTRACTS

Vol. 6, No. 2, January 31, 1952

TABLE OF CONTENTS

Category	Abstract	Page
REPORTS REFERENCE LIST		iii
GENERAL	489	61
Atomic Power	489	
Research Programs	491	
BIOLOGY AND MEDICINE	494	61
Radiation Effects	505	
Radiation Hazards and Protection	513	
Radiation Sickness	520	
Radiography	521	
Radiotherapy	523	
Toxicology Studies	526	
Tracer Applications	529	
CHEMISTRY	533	68
Analytical Procedures	543	
Crystallography and Crystal Structure	550	
Deuterium and Deuterium Compounds	551	
Fluorine and Fluorine Compounds	552	
Radiation Effects	556	
Rare Earths and Rare-earth Compounds	558	
Syntheses	565	
Tracer Applications	572	
Uranium and Uranium Compounds	573	
ENGINEERING	575	73
Heat Transfer	577	
Vacuum Systems	582	
MINERALOGY, METALLURGY, AND CERAMICS	588	75
Corrosion	588	
Geology and Mineralogy	589	
Metals and Metallurgy	591	

Category	Abstract	Page
PHYSICS	608	78
Aerosols	609	
Cosmic Radiation	610	
Crystallography and Crystal Structure	617	
Electrical Discharge	620	
Electrons	621	
Gases	622	
Instruments	625	
Mass Spectrography	636	
Mathematics	637	
Measuring Instruments and Techniques	638	
Mesons	669	
Meteorology	675	
Neutrons	678	
Nuclear Physics	679	
Nuclear Properties	686	
Nuclear Reactors	694	
Nuclear Transformation	698	
Particle Accelerators	713	
Radiation Absorption and Scattering	715	
Radiation Effects	730	
Radioactivity	731	
Spectroscopy	743	
Theoretical Physics	744	
Tracer Applications	755	
AUTHOR INDEX		INDEX-1
NUMERICAL INDEX OF REPORTS		INDEX-5
NEW NUCLEAR DATA		SUPPLEMENT-1

REPORTS REFERENCE LIST

Vol. 6, No. 2

The abstract journal number for each report is listed at the upper right of the entry. If the number bears an asterisk, the report is title listed only and no abstract is included.

U. S. ATOMIC ENERGY COMMISSION DECLASSIFIED REPORTS

AECD-3281 698
Argonne National Lab.
STUDIES WITH THE RANGER (sects. III and IV only); by D. L. Hill. Apr. 14, 1947. Decl. Dec. 5, 1951. 57p. (AECD-3281; CP-3800(sects. III and IV))

AECD-3282 495
Radiation Lab., Univ. of Calif.
MEDICAL AND HEALTH PHYSICS QUARTERLY REPORT; APRIL, MAY, AND JUNE, 1951. Aug. 14, 1951. Decl. Dec. 5, 1951, 59p. (AECD-3282; UCRL-1437)

AECD-3282(sect.I) 496
Radiation Lab., Univ. of Calif.
THE METABOLIC PROPERTIES OF VARIOUS MATERIALS; sect.I of MEDICAL AND HEALTH PHYSICS QUARTERLY REPORT; APRIL, MAY, AND JUNE, 1951; by J. G. Hamilton Aug. 14, 1951. Decl. Dec. 5, 1951. 27p. (AECD-3282(sect. I))

AECD-3282(sect.II) 497
Radiation Lab., Univ. of Calif.
BIOLOGICAL STUDIES OF RADIATION EFFECTS, sect.II of MEDICAL AND HEALTH PHYSICS QUARTERLY REPORT, APRIL, MAY, AND JUNE, 1951; by J. H. Lawrence. Aug. 14, 1951. Decl. Dec. 5, 1951. 25p. (AECD-3282(sect.II))

AECD-3283 731*
[Metallurgical Project. Univ. of Chicago]
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AECD-3284 732
Metallurgical [Lab.]; [Univ. of Chicago]
CHEMICAL RESEARCH—RADIOCHEMISTRY; REPORT FOR MONTH ENDING APRIL 17, 1943; J. Franck, Director. [nd] Decl. with deletions Dec. 11, 1951. 21p. (AECD-3284; CC-579)

U. S. ATOMIC ENERGY COMMISSION UNCLASSIFIED REPORTS

AECU-1711 552
Illinois Inst. of Tech.
THE ACIDS OF THE HYDROGEN FLUORIDE SYSTEM; I. PROGRESS REPORT FOR THE PERIOD SEPTEMBER 1, 1950, TO MAY 15, 1951; by Alan F. Clifford. II. RENEWAL PROPOSAL FOR THE PERIOD SEPTEMBER 1, 1951, TO AUGUST 31, 1952; by Mervin E. Runner. [nd] 10p. (AECU-1711)

AECU-1726 489*
Columbia Univ.
POWER RECOVERY AT BROOKHAVEN; by Charles E. Lucke. Second draft Aug. 1, 1950. 51p. (AECU-1726; Report No. 2) (See also NSA 5-3285)

AECU-1727 490*
Columbia Univ.
POWER RECOVERY AT BROOKHAVEN; by Charles E. Lucke. First draft Sept. 1, 1950. 81p. (AECU-1727; Report No. 3)

AECU-1728 553
[Oak Ridge National Lab.]
PRODUCTION OF PURIFIED ANTHRACENE AND CLEAR ANTHRACENE CRYSTALS; by P. R. Bell, Jr. [nd] 3p. (AECU-1728)

AECU-1729 679
Argonne National Lab.
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AECU-1731 565
Presbyterian Hospital, Chicago
THE TURNOVER RATE OF FIBRINOGEN IN THE DOG[1,2] (thesis); by Robert E. Madden and R. Gordon Gould. [nd] 20p. (AECU-1731)

AECU-1732 529
Michigan State Coll.
THE REDISTRIBUTION OF RADIOCALCUIM AND RADIOIODINE DURING HISTAMINE SHOCK; by Marvin Murray, W. Doyne Collings, and Lester F. Wolterink. 15p. [nd] (AECU-1732)

AECU-1734 543
Illinois Univ.
FLUOROMETRIC DETERMINATION OF TRACES OF BERYLLIUM; by H. A. Laitinen and Pekka Kivalo. [nd] 28p. (AECU-1734)

AECU-1735 566
Sloan-Kettering Inst. for Cancer Research
STUDIES ON THE METABOLISM OF THE NUCLEIC ACIDS; by Aaron Bendich. [nd] 36p. (AECU-1735)

AECU-1736 567
Utah Univ.
THE BACK-REACTION IN THE PHOTOLYSIS OF WATER BY ILLUMINATED CHLOROPLAST FRAGMENTS (abstract) by John D. Spikes. [1951]. 1p. (AECU-1736)

AECU-1737 534
Utah Univ.
STOICHIOMETRY OF THE REACTIONS INVOLVED IN THE EVOLUTION OF OXYGEN BY ISOLATED CHLOROPLASTS UPON ILLUMINATION (abstract); by John D. Spikes. [1951] 1p. (AECU-1737)

AECU-1738 498
Utah Univ.
SOME PHOTOCHEMICAL INVESTIGATIONS (abstract); by Henry Eyring, Rufus Lumry, and John D. Spikes. [1951] 3p. (AECU-1738)

AECU-1739 540
Utah Univ.
OXIDATION-REDUCTION POTENTIALS IN PHOTOSYNTHESIS (abstract); by Rufus Lumry and John Spikes. [1951] 2p. (AECU-1739)

AECU-1740 561
Ames Lab.
QUANTITATIVE CALCULATION OF THE BEHAVIOR OF ELUTION BANDS IN THE SEPARATION OF RARE EARTHS ON ION-EXCHANGE COLUMNS; by F. H. Spedding and J. E. Powell. Nov. 24, 1951. 3p. (AECU-1740)

AECU-1741 535
College of Sciences and Arts, State Coll. of Wash.
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AECU-1742 556
Argonne National Lab.
EFFECT OF IONIZING RADIATIONS ON LIQUIDS; by Sheffield Gordon, E. J. Hart, and P. D. Walsh. Nov. 1, 1951. 11p. (AECU-1742; ANL-4613(p.52-63); UAC-461)

AECU-1743 505
[Los Alamos Scientific Lab.]
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AECU-1746 575
Illinois Univ.
A SIMPLE, EFFECTIVE HIGH PRESSURE VALVE; by E. W. Comings and H. G. Drickamer. [nd] 3p. (AECU-1746)

AECU-1748 536
Wisconsin Univ.
THE PREPARATION OF Li^6 TARGETS; by Fay Ajzenberg. [nd] 4p. (AECU-1748)

AECU-1751 572
Brookhaven National Lab.
EXCHANGE BETWEEN THE TRIS-(5,6-DIMETHYL-1,10-PHENANTHROLINE) COMPLEXES OF IRON (II) AND (III); by Lois Eimer and A. I. Medalia. [nd] 6p. (AECU-1751)

AECU-1752 530
Connecticut Agricultural Experiment Station
EFFECT OF STUNTING AGENTS, *FUSARIUM LYCOPERSICI* (FL) AND MALEIC HYDRAZIDE (MH), UPON PHOSPHORUS DISTRIBUTION IN TOMATO; by Paul E. Waggoner and A. E. Dimond. [nd] 1p. (AECU-1752)

AECU-1768 499
Minnesota Univ.
FACTORS AND RESULTS IN THE PARTIAL VACUUM INOCULATION OF SEEDLING CORN WITH *USTILAGO ZEAE* (abstract); by J. B. Rowell and J. E. DeVay. [nd] 1p. (AECU-1768)

AECU-1769 537
Illinois Univ.
DIFFUSION THROUGH AN INTERFACE; BINARY SYSTEM; by L. H. Tung and H. G. Drickamer. [nd] 18p. (AECU-1769)

AECU-1771 620
Utah Univ.
INDUCTION OF A CHEMICAL REACTION IN A HIGH FREQUENCY DISCHARGE; II. FIXATION OF NITROGEN IN A CROSSED DISCHARGE; by William S. Partridge, Ransom B. Parlin, and Bruno J. Zwolinski. Aug. 23, 1951. 11p. (AECU-1771; Technical Report No. III)

ANL-4625 500
Argonne National Lab.
QUARTERLY REPORT, FEBRUARY, MARCH, APRIL, 1951; DIVISION OF BIOLOGICAL AND MEDICAL RESEARCH; Austin M. Brues, ed. [nd] 229p. (ANL-4625)

ANL-4625(p.14-20, 41-54, 57, 60-3, 125-41, 152-4) 520
Argonne National Lab.
RADIATION SICKNESS, p.14-20, 41-54, 57, 60-3, 125-41, 152-4 of QUARTERLY REPORT, FEBRUARY, MARCH, APRIL, 1951; DIVISION OF BIOLOGICAL AND MEDICAL RESEARCH; Austin M. Brues, ed. [nd] 46p. (ANL-4625 (p.14-20, 41-54, 57, 60-3, 125-41, 152-4))

ANL-4625(p.21-40. 56, 58-9, 64-5, 91-8, 164-70, 177-86, 192) 506
Argonne National Lab.
RADIATION EFFECTS, p.21-40, 56, 58-9, 64-5, 91-8, 164-70, 177-86, 192 of QUARTERLY REPORT, FEBRUARY, MARCH, APRIL, 1951; DIVISION OF BIOLOGICAL AND MEDICAL RESEARCH; Austin M. Brues, ed. [nd] 51p. (ANL-4625(p.21-40, 56, 58-9, 64-5, 91-8, 164-70, 177-86, 192))

ANL-4625(p.55, 72-84, 99-124, 142-51, 187-91, 193-4, 209-21) 526
Argonne National Lab.
TOXICITY, p.55, 72-84, 99-124, 142-51, 187-91, 193-4, 209-21 of QUARTERLY REPORT, FEBRUARY, MARCH, APRIL, 1951; DIVISION OF BIOLOGICAL AND MEDICAL RESEARCH; Austin M. Brues, ed. [nd] 70p. (ANL-4625(p.55, 72-84, 99-124, 142-51, 187-91, 193-4, 209-21))

ANL-4625(p.66-71) 625
Argonne National Lab.
TECHNIQUES IN THE PREPARATION OF RADIOACTIVE GLASS BEADS, p.66-71 of QUARTERLY REPORT, FEBRUARY, MARCH, APRIL, 1951; DIVISION OF BIOLOGICAL AND MEDICAL RESEARCH; by W. E. Kisieleski, G. Svihla, and A. M. Brues. [nd] 6p. (ANL-4625(p.66-71))

ANL-4625(p.85-90) 501
Argonne National Lab.
ON ESTIMATION OF TOTAL RADIATION DOSAGE FROM THE METABOLIZED OR COMPARTMENTALIZED ISOTOPE, p.85-90 of QUARTERLY REPORT, FEBRUARY, MARCH, APRIL, 1951; DIVISION OF BIOLOGICAL AND MEDICAL RESEARCH; by Austin M. Brues. [nd] 6p. (ANL-4625(p.85-90))

ANL-4625(p.155-63) 502
Argonne National Lab.
MECHANICS OF CELL DIVISION; I. THE LIVING SPINDLE, p.155-63 of QUARTERLY REPORT, FEBRUARY, MARCH, APRIL, 1951; DIVISION OF BIOLOGICAL AND MEDICAL RESEARCH; by T. N. Tahmisian. [nd] 9p. (ANL-4625 (p.155-63))

ANL-4625(p.171-6) 568
Argonne National Lab.
SYNTHESIS, p.171-6 of QUARTERLY REPORT, FEBRUARY, MARCH, APRIL, 1951; DIVISION OF BIOLOGICAL AND MEDICAL RESEARCH; Austin M. Brues, ed. [nd] 6p. (ANL-4625(p.171-6))

ANL-4625 (p.195-208) 640
Argonne National Lab.
MEASURING INSTRUMENTS AND TECHNIQUES, p.195-208 of QUARTERLY REPORT FEBRUARY, MARCH, APRIL, 1951; DIVISION OF BIOLOGICAL AND MEDICAL RESEARCH; Austin M. Brues, ed. [nd] 14p. (ANL-4625 (p.195-208))

BNL-131 492
Brookhaven National Lab.
ANNUAL REPORT; JULY 1, 1951. 151p. [nd] (BNL-131)

BNL-1010 546
Western Reserve Univ. School of Medicine
PREPARATION AND PROPERTIES OF A CELL-FREE FORMIC HYDROGENLYASE SYSTEM FROM ESCHERICHIA COLI; by Howard Gest and Martin Gibbs; Western Reserve Univ. School of Medicine and Brookhaven National Lab. 8p. [nd] (BNL-1010)

BNL-1018 503
Brookhaven National Lab.
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BNL-1019 507
Brookhaven National Lab.
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Brookhaven National Lab.
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Brookhaven National Lab.
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Brookhaven National Lab.
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Brookhaven National Lab.
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COO-81 591
Armour Research Foundation
PHASE DIAGRAMS OF ZIRCONIUM-BASE BINARY ALLOYS; SEPTEMBER 1—NOVEMBER 1, 1951 (Report No. 5); by D. J. McPherson. Nov. 27, 1951. 44p. (COO-81)

COO-84 680
Case Inst. of Tech.
NUCLEAR PHYSICS PROGRAM; SEPTEMBER 15, 1950, TO SEPTEMBER 15, 1951. [nd] 32p. (COO-84)

CF-50-6-114 643*
[Oak Ridge National Lab.]
CALIBRATION OF THE 4π HIGH PRESSURE ION CHAMBER; by James W. Cobble. [June 1950]. 13p. (CF-50-6-114)

(CF-51-3-120) 577
[Oak Ridge National Lab.]
PRELIMINARY STEAM POWER CYCLE STUDIES FOR FULL SCALE HOMOGENOUS REACTORS; by W. K. Stair. Mar. 12, 1951. 23p. (CF-51-3-120)

HW-20668 513
Hanford Works
RADIOACTIVE PLANKTON FROM THE COLUMBIA RIVER; by R. W. Coopey. Mar. 29, 1951. 21p. (HW-20668)

ISC-105 573
Ames Lab.
STUDY OF THE KINETICS OF THE REACTION BETWEEN URANIUM, H_2, HD, and D_2; by Harry J. Svec and Frederick R. Duke. Mar. 1, 1950. 36p. (ISC-105)

ISC-142 562
Ames Lab
CONDUCTANCES, TRANSFERENCE NUMBERS, AND ACTIVITY COEFFICIENTS OF SOME LOW ATOMIC NUMBER RARE EARTHS IN AQUEOUS SOLUTION; by F. H. Spedding and Paul Edward Porter. Mar. 1951. (ISC-142)

ISC-148 559
Ames Lab.
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ISC-154 735
Ames Lab.
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Ames Lab.
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ISC-169 563
Ames Lab.
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ISC-185 539
Ames Lab.
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ISC-187 558
Ames Lab.
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K-841 617
Carbide and Carbon Chemicals Co., K-25
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KAPL-637 592
Knolls Atomic Power Lab.
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LA-1302 593
Los Alamos Scientific Lab.
ACCELERATED CORROSION TEST OF STAINLESS STEEL SAMPLES IN AN EFFORT TO ESTABLISH GALVANIC ATTACK; by James T. Waber and Santon Waber. June 1,

LA-1303 644
Northwestern Univ.
TRAINING MANUAL FOR MICROSCOPISTS MEASURING ALPHA-TRITON TRACES FROM LITHIUM-SIX DISINTEGRATIONS IN PHOTOGRAPHIC EMULSIONS; by J. Haugsnes and J. H. Roberts. Oct. 1951. 21p. (LA-1303)

MLM-618 645
Mound Lab.
COUNTING SYSTEMS FOR PULSES OF WIDE DYNAMIC RANGE (Ad Interim Report); by W. H. Baker. Oct. 15, 1951. 38p. (MLM-618)

NEPA-1015 578*
NEPA Div.
REPORT ON THE THERMAL CONDUCTIVITY OF SOME REFRACTORY MATERIALS AT ELEVATED TEMPERATURES; by M. A. Schwartz. Apr. 1949. 17p. (NEPA-1015)

NEPA-1645 646
NEPA Div.
SCINTILLATION COUNTING; by Joe Keagy Bair. Mar. 16, 1951. 81p. (NEPA-1645)

NEPA-1701 647
NEPA Div.
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NYO-548 597
[Carnegie Inst. of Tech.]
PROGRESS REPORT FOR JUNE 1951; by Alan Rothman, D. S. McKinney, and J. C. Warner. [nd] 9p. (NYO-548)

NYO-580 598
Massachusetts Inst. of Tech.
SOLID SOLUTIONS AND GRAIN BOUNDARIES (Technical Progress Report No. 8, Scope II); by B. L. Averbach, M. Cohen, P. A. Flinn, L. L. Seigle, E. E. Underwood, W. E. Flanagan, P. S. Rudman, J. Hilliard. Sept. 30, 1951. 7p. (NYO-580)

NYO-653 610
Puerto Rico Univ.
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NYO-798 538
Pennsylvania State Coll.
POLAROGRAPHIC BEHAVIOR OF ORGANIC COMPOUNDS; XI. THE ALPHA-BROMO-n-ALKANOIC ACIDS; by Isadore Rosenthal, Charles H. Albright, and Philip J. Elving. Aug. 30, 1951. 23p. (NYO-798)

NYO-811 700
Columbia Univ.
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NYO-827 591
Metals Research Lab., Carnegie Inst. of Tech.
ELECTROCHEMICAL STUDIES OF NON-AQUEOUS MELTS QUARTERLY PROGRESS REPORT; PERIOD ENDING OCTOBER 1, 1951; by Robert F. Mehl and Gerhard Derge. Nov. 6, 1951. 9p. (NYO-827)

NYO-859 618
Massachusetts Inst. of Tech.
FUNDAMENTALS OF COLD WORKING AND RECRYSTALLIZATION (Technical Progress Report No. 4, Scope III); by B. L. Averbach, M. Cohen, S. Allen, L. Mager, G. P. Conard, and P. Fopiano. Sept. 30, 1951. 8p. (NYO-859)

NYO-933 600
Columbia Univ.
THE STUDY OF DIFFUSIONLESS PHASE CHANGES IN SOLID METALS AND ALLOYS; PROGRESS REPORT FOR JUNE 1 TO AUGUST 31, 1951; by T. A. Read, L. C. Chang, M. W. Burkart, D. S. Lieberman, S. Zirinsky, J. Intrater, R. Bakish, and J. W. Semmel. [nd] 6p. (NYO-933)

NYO-1559 677
New York Univ.
ANNUAL PROGRESS REPORT; AEC AIR POLLUTION PROJECT; METEOROLOGICAL PHASE; by H. A. Panofsky and I. A. Singer. June 30, 1951. 61p. (NYO-1559)

NYO-1568 628
New York Operations Office
TEST AND EVALUATION OF VIBRATOR POWER SUPPLY; by Robert T. Graveson. Aug. 27, 1951. 3p. (NYO-1568)

NYO-1571 515
Sedgwick Labs. of Sanitary Science, Mass. Inst. of Tech.
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NYO-3147 579
Columbia Univ.
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NYO-3177 601
Metals Research Lab., Carnegie Inst. of Tech.
PROGRESS REPORT FOR JULY, AUGUST, SEPTEMBER, 1951; by R. Smoluchowski, L. Couling, S. Hayes, R. Flannagan, C. W. Haynes, B. Sawyer, R. W. Turner, and A. Pranatis. Oct. 15, 1951. 3p. (NYO-3177)

ORO-54 504
Tennessee Univ.
QUARTERLY PROGRESS AND WORK ACCOMPLISHMENT REPORT FOR QUARTER ENDING SEPTEMBER 30, 1951. [nd] 33p. (ORO-54)

SEP-80 602
Metallurgical Labs., Sylvania Electric Products, Inc.
THE THEORIES OF THE SINTERING PROCESS; A GUIDE TO THE LITERATURE (1931-1951); by Herbert B. Michaelson. Issued Nov. 29, 1951. 41p. (SEP-80)

SEP-81 603
Metallurgical Labs., Sylvania Electric Products, Inc.
SELF-DIFFUSION OF METALS AND ASSOCIATED PHENOMENA (VI); PROGRESS REPORT; APRIL 1, 1951 - NOVEMBER 30, 1951; by B. H. Alexander, R. W. Balluffi, M. H. Dawson, H. P. Kling, and F. D. Rosi. Issued Dec. 3, 1951. 17p. (SEP-81)

TID-5059 491*
Technical Information Service, AEC
CORPORATE AUTHOR ENTRIES USED IN CATALOGING REPORTS BY TECHNICAL INFORMATION SERVICE, AEC. [nd] (TID-5059)

UCLA-171 508
Atomic Energy Project, Univ. of Calif.
PAPER CHROMATOGRAPHIC STUDY OF FREE AMINO ACIDS OF YOLK OF DEVELOPING NORMAL AND X-IRRADIATED CHICK EMBRYOS; by Richard F. Riley and Esther Richter. Nov. 26, 1951. 8p. (UCLA-171)

UCRL-1508 715
Radiation Lab., Univ. of Calif.
DETECTION OF AZIMUTHAL POLARIZATION IN DOUBLE N-P SCATTERING AT 150 Mev (abstract); by L. F. Wouters. Oct. 1951. 1p. (UCRL-1508)

UCRL-1510 531
Radiation Lab., Univ. of Calif.
THE PATH OF CARBON IN PHOTOSYNTHESIS: XIII. pH EFFECTS IN C^{14}O$_2$ FIXATION BY SCENEDESMUS; by C. Ouellet and A. A. Benson. Oct. 23, 1951. 15p. (UCRL-1510)

UCRL-1514 736
Radiation Lab., Univ. of Calif.
L ELECTRON CAPTURE AND ALPHA DECAY IN Np^{235}; by Ralph A. James, Albert Ghiorso, and Donald Orth. Oct. 24, 1951. 7p. (UCRL-1514)

UCRL-1517 655
Radiation Lab., Univ. of Calif.
A γ-RAY DETECTOR EMPLOYING MULTIPLE SCATTERING SEPARATION OF ELECTRON PAIRS; by R. H. Hildebrand, N. Knable, and C. E. Leith. Oct. 24, 1951. 6p. (UCRL-1517)

UCRL-1530 669
Radiation Lab., Univ. of Calif.
ANGULAR DISTRIBUTION OF π^+ MESONS PRODUCED IN P-P COLLISIONS (abstract); by Marian Whitehead and Chaim Richman. Nov. 1, 1951. 1p. (UCRL-1530)

UCRL-1535 656
Radiation Lab., Univ. of Calif.
ELECTRON PICKUP BY FAST C^{12} NUCLEI IN EMULSION (abstract); by Peter C. Giles and Walter H. Barkas. Oct. 1951. 1p. (UCRL-1535)

UCRL-1542 716
Radiation Lab., Univ. of Calif.
FAST PROTONS FROM 270-MEV NEUTRON-DEUTERON COLLISIONS (thesis); by James Warren Hadley. Nov. 5, 1951. 44p. (UCRL-1542)

UCRL-1543 670
Radiation Lab., Univ. of Calif.
THE YIELD OF NEUTRAL MESONS FROM PROTON BOMBARDMENT OF LIGHT NUCLEI; by R. W. Hales, R. H. Hildebrand, N. Knable, and B. J. Moyer. Nov. 5, 1951. 7p. (UCRL-1543)

UCRL-1546 686
Radiation Lab., Univ. of Calif.
NUCLEAR CROSS SECTIONS FOR HIGH ENERGY NEUTRON AND PROTONS (abstract); by R. Jastrow and J. E. Roberts. [nd] 1p. (UCRL-1546)

UCRL-1547 737
Radiation Lab., Univ. of Calif.
ALUMINUM–24; A DELAYED HEAVY-PARTICLE EMITTER (abstract); by Ann C. Birge. Nov. 1, 1951. 1p. (UCRL-1547)

UCRL-1550 701
Radiation Lab., Univ. of Calif.
HIGH ENERGY PHOTOPROTONS FROM CARBON (abstract); by J. W. Rose and W. S. Gilbert. Nov. 1951. 1p. (UCRL-1550)

UCRL-1551 702
Radiation Lab., Univ. of Calif.
PHOTODISINTEGRATION OF THE DEUTERON (abstract); by W. S. Gilbert and J. W. Rose. Nov. 2, 1951. 1p. (UCRL-1551)

UCRL-1552 703
Radiation Lab., Univ. of Calif.
PHOTO-DISSOCIATION OF DEUTERON BY HIGH ENERGY GAMMA-RAYS (abstract); by Seishi Kikuchi. Nov. 2, 1951. 1p. (UCRL-1552)

UCRL-1553 671
Radiation Lab., Univ. of Calif.
PHOTOMESONS FROM DEUTERIUM (abstract); by R. Stephen White, Mark J. Jakobson, and Alvin G. Schulz. Nov. 2, 1951. 2p. (UCRL-1553)

UCRL-1554 717
Radiation Lab., Univ. of Calif.
ELASTIC SCATTERING OF 190-MEV DEUTERONS BY PROTONS (abstract); by Martin O. Stern. Nov. 2, 1951. 1p. (UCRL-1554)

UCRL-1555 718
Radiation Lab., Univ. of Calif.
EFFECT OF CHEMICAL STRUCTURE ON STOPPING POWERS FOR HIGH ENERGY PROTONS (abstract); by T. J. Thompson. Nov. 2, 1951. 1p. (UCRL-1555)

UCRL-1556 687
Radiation Lab., Univ. of Calif.
INFLUENCE OF WELL SHAPE ON THE PICKUP PROCESS IN DEUTERIUM (abstract); by Ira L. Karp. Nov. 1951. 1p. (UCRL-1556)

UCRL-1576 629
Radiation Lab., Univ. of Calif.
DISCRIMINATOR CALIBRATOR; by Alex J. Stripeika and Gene B. Newton. Nov. 27, 1951. 11p. (UCRL-1576)

UCRL-1579 521
Radiation Lab., Univ. of Calif.
FLUORESCENT CRYSTAL COUNTING IN MEDICAL TRACER RESEARCH (abstract); by H. O. Anger. Nov. 1951. 1p. (UCRL-1579)

UR-189 509
Atomic Energy Project, Univ. of Rochester
QUARTERLY TECHNICAL REPORT JULY 1, 1951, THRU SEPTEMBER 30, 1951; Henry A. Blair, Director. Oct. 25, 1951. 76p. (UR-189)

UR-189(p.6-45) 510
Atomic Energy Project, Univ. of Rochester
RADIUM TOXICITY AND EXTERNAL RADIATION—BIOLOGICAL EFFECTS, p. 6-45 of QUARTERLY TECHNICAL REPORT JULY 1, 1951, THRU SEPTEMBER 30, 1951; Henry A. Blair, Director. Oct. 25, 1951. 40p. (UR-189(p.6-45))

UR-189(p.46-55) 516
Atomic Energy Project, Univ. of Rochester
EXTERNAL RADIATION—TOLERANCE AND THERAPY, p. 46-55 of QUARTERLY TECHNICAL REPORT JULY 1, 1951, THRU SEPTEMBER 30, 1951; Henry A. Blair, Director. Oct. 25, 1951. 10p. (UR-189(p.46-55))

UR-189(p.56-73) 657
Atomic Energy Project, Univ. of Rochester
INSTRUMENTS—RESEARCH AND DEVELOPMENT, p.56-73 of QUARTERLY TECHNICAL REPORT JULY 1, 1951, THRU SEPTEMBER 30, 1951; Henry A. Blair, Director. Oct. 25, 1951. 18p. (UR-189(p. 56-73))

UR-190 528
Atomic Energy Project, Univ. of Rochester
ACUTE TOXICITY OF INHALED THORIUM COMPOUNDS; by Robert H. Hall, Catherine A. Stroud, James K. Scott, Robert E. Root, Luville T. Steadman, and Herbert E. Stokinger. Nov. 13, 1951. 25p. (UR-190)

(Y-F5-22) 694*
[Oak Ridge National Lab., Y-12 Area]
NUMERICAL INTEGRATION OF THE MULTI-GROUP REACTOR EQUATIONS IN CYLINDRICAL GEOMETRY; by M. C. Edlund. Sept. 27, 1950. 15p. (Y-F5-22)

(Y-F10-20) 695*
[Oak Ridge National Lab., Y-12 Area]
RESULTS OF A TEST OF THE LINEAR APPROXIMATION MULTIGROUP CALCULATIONS; by D. K. Holmes. Nov. 6, 1950. 6p. (Y-F10-20)

OTHER UNCLASSIFIED REPORTS OF SPECIAL INTEREST TO AEC LABORATORIES

ACSIL/49/2482 675*
National Physical Lab. (Great Britain)
THE EFFECTS OF VELOCITY AND TEMPERATURE OF DISCHARGE ON THE SHAPE OF SMOKE PLUMES FROM A FUNNEL OR CHIMNEY; EXPERIMENTS IN A WIND TUNNEL; by L. W. Bryant. Jan. 1949. 29p. (ACSIL/49/2482)

AERE-C/M-64 544*
Atomic Energy Research Establishment, Harwell, Berks (England)
THE DETERMINATION OF MOLYBDENUM IN URANIUM MOLYBDENUM ALLOYS; by M. Gibson. May 1950. 6p. (AERE-C/M-64)

AERE-C/M-65 545*
Atomic Energy Research Establishment, Harwell, Berks (England)
THE DETERMINATION OF URANIUM IN URANIUM MERCURY ALLOY; by M. Gibson. May 1950. 2p. (AEPE-C/M/65)

AERE-C/R-651 639
Atomic Energy Research Establishment, Harwell, Berks (England)
BORON TRIFLUORIDE FOR NEUTRON DETECTION; PREPARATION AND INVESTIGATION OF THE PRODUCT; by F. Hudswell, J. S. Nairn, and K. L. Wilkinson. July 31, 1951. 33p. (AERE-C/R-651)

AERE G/M-100 699
Atomic Energy Research Establishment, Harwell, Berks (England)
THE $^{12}C(\gamma,3\alpha)$ AND $^{16}O(\gamma,4\alpha)$ REACTIONS AT GAMMA-RAY ENERGIES UP TO 40 MEV; by F. K. Goward and J. J. Wilkins. [nd] 3p. (AERE G/M-100)

CEA-87 547
Commissariat à l'Énergie Atomique
ANALYSIS OF HYDROGEN-DEUTERIUM MIXTURES AND OF MIXTURES OF HEAVY-WATER AND LIGHT-WATER BY MEANS OF A MASS SPECTROMETER (ANALYSE DES MÉLANGES HYDROGÈNE-DEUTERIUM-ET DES MÉLANGES D'EAU LOURDE ET D'EAU LÉGÈRE-AU MOYEN DU SPECTROMÈTRE DE MASSE); by J. Chenouard, J. Gueron, and E. Roth. July, 1951. 35p. (CEA-87)

NP-1436 648*
RCA Victor Div., Radio Corp. of America
RESEARCH INVESTIGATION OF IONIZATION CHAMBERS; FIRST QUARTERLY PROGRESS REPORT FOR OCTOBER 14, 1949, TO JANUARY 14, 1950; by J. H. Reisner, J. R. Parker, and W. L. McDermid. [nd] Decl. Dec. 4, 1951. 43p. (NP-1436)

NP-1567 638
RCA Victor Div., Radio Corp. of America
RESEARCH INVESTIGATION OF IONIZATION CHAMBERS; SECOND QUARTERLY PROGRESS REPORT FOR JANUARY 14 TO APRIL 14, 1950; by J. H. Reisner, J. R. Parker, and W. L. McDermid. 1950. Decl. Dec. 4, 1951. 43p. (NP-1567)

NP-3026 649*
RCA Victor Div., Radio Corp. of America
RESEARCH INVESTIGATION OF IONIZATION CHAMBERS; FIFTH QUARTERLY REPORT; NOVEMBER 14, 1950–JANUARY 14, 1951; by J. R. Parker and W. L. McDermid. [nd] Decl. Dec. 4, 1951. 11p. (NP-3026)

NP-3097 650
RCA Victor Div., Radio Corp. of America
RESEARCH INVESTIGATION OF IONIZATION CHAMBERS; FINAL REPORT; OCTOBER 15, 1949–MARCH 31, 1951; by J. R. Parker and W. L. McDermid. [nd] Decl. without deletions Dec. 4, 1951. 104p. (NP-3097)

NP-3176 651*
RCA Victor Div., Radio Corp. of America
RESEARCH INVESTIGATION OF IONIZATION CHAMBERS; FOURTH QUARTERLY REPORT; JULY 14, 1950–NOVEMBER 14, 1950; by J. H. Reisner, J. R. Parker, and W. L. McDermid. [nd] Decl. Dec. 4, 1951. 72p. (NP-3176)

NP-3319 652*
RCA Victor Div., Radio Corp. of America
RESEARCH INVESTIGATION OF IONIZATION CHAMBERS; FIRST QUARTERLY REPORT; MAY 1, 1951–JULY 31, 1951; by J. R. Parker. [nd] Decl. Dec. 4, 1951. 46p. (NP-3319)

NP-3494 594
Mass. Inst. of Tech.
THE HABIT PHENOMENON IN THE MARTENSITIC TRANSFORMATION; by E. S. Machlin and Morris Cohen. Aug. 1, 1951. 60p. (NP-3494; Technical Report No. 5)

NP-3495 588
Corrosion Lab., Mass. Inst. of Tech.
RESISTANCE OF TITANIUM TO SULFURIC AND HYDROCHLORIC ACIDS INHIBITED BY FERRIC AND CUPRIC IONS (Technical Report No. 6); by Joseph R. Cobb and Herbert H. Uhlig. June 1951. 9p. (NP-3495)

NP-3496 494*
Naval Medical Research Inst., Bethesda
CHEMICAL AND RADIOCHEMICAL STUDIES OF THE DISTRIBUTION OF GALLIUM IN THE ORGANISM; by Horace C. Dudley, John I. Munn, and Katherine E. Henry. Oct. 20, 1949. 12p. (NP-3496)

NP-3497 595
Mass. Inst. of Tech.
STRESS-INDUCED TRANSFORMATIONS OF RETAINED AUSTENITE IN HARDENED STEEL (Technical Report No. 3); by B. L. Averbach, S. G. Lorria, and M. Cohen. Aug. 1, 1951. 26p. (NP-3497)

NP-3501 676*
Massachusetts Inst. of Tech.
RESEARCH ON TURBULENCE AND DIFFUSION OF PARTICULATE MATTER IN THE LOWER LAYERS OF THE ATMOSPHERE; PROGRESS REPORT NO. 6; FEBRUARY 1-APRIL 30, 1950; by E. Wendell Hewson. May 10, 1950. 7p. (NP-3501)

NP-3502 713
Research Lab. of Electronics, Mass. Inst. of Tech.
PARTICLE DYNAMICS IN THE LINEAR ACCELERATOR (Technical Report No. 204); by J. R. Terrall and J. C. Slater. May 31, 1951. 5p. (NP-3502)

NP-3503 548
Research Lab. of Electronics, Mass. Inst. of Tech.
THE MICROWAVE SPECTRUM OF KETENE (Technical Report No. 192); by H. R. Johnson and M. W. P. Strandberg. Mar. 14, 1951. 21p. (NP-3503)

NP-3504 653
New York Univ.
FLUORESCENCE AND CONDUCTIVITY PHENOMENA; FIFTH QUARTERLY REPORT FOR MONTHS INCLUDING FEBRUARY, MARCH, APRIL. May 1951. 67p. (NP-3504; Progress Report 5)

NP-3509 527
Naval Medical Research Inst., Bethesda
EFFECTS OF INJECTION OF RADIOGALLIUM (Ga^{72}); by H. C. Dudley, L. J. Louviere, and J. C. Shaw. Sept. 15, 1951. 11p. (NP-3509)

NP-3510 654
Laboratory for Nuclear Science and Engineering, Mass. Inst. of Tech.
CO_2 IONIZATION CHAMBER TECHNIQUES FOR C^{14} MEASUREMENT; by Gordon L. Brownell and Helen S. Lockhart. [nd] (NP-3510; Technical Report No. 56)

NP-3526 627*
Columbia Univ.
MANUAL ON THERMOMETRY WITH EMPHASIS ON THERMOCOUPLE TECHNIQUES; by H. Dean Baker. Copyright 1950. 201p. (NP-3526)

NP-3527 514
[Atomic Energy Research Establishment, Harwell, Berks (England)]
SAFETY HANDBOOK; by J. D. Cockcroft. [nd] 65p. (NP-3527)

NRL-3871 596
Naval Research Lab.
A MISCHMETAL ALUMINUM ALLOY FOR ELEVATED TEMPERATURE SERVICE; by B. M. Loring, W. H. Baer and C. G. Ackerlind. Nov. 1, 1951. 24p. (NRL-3871)

TEM-147 589
Geological Survey
AIRBORNE RADIOACTIVITY SURVEY OF THE RED DESERT REGION, SWEETWATER COUNTY, WYOMING; by R. A. Nelson, W. N. Sharp, and F. W. Stead. July 1951. 30p. (TEM-147)

U-12161 609*
Central Aerosol Labs., Columbia Univ.
POLYDISPERSITY AND NUCLEATION IN AEROSOLS; PROGRESS REPORT; March 1–May 31, 1950; by Victor K. La Mer. [nd] 8p. diagrs. (U-12161; Progress Report No. 2)

WAL-401/46-4 604
Armour Research Foundation
DEVELOPMENT OF PROTECTIVE COATING FOR TITANIUM AND TITANIUM ALLOYS; JUNE 1–SEPTEMBER 30, 1951; by William H. Colner and Howard T. Francis. [nd] 17p. (WAL-401-46-4; Interim Technical Report No. 1)

GENERAL

ATOMIC POWER

489
Columbia Univ.
POWER RECOVERY AT BROOKHAVEN; by Charles E. Lucke. Second draft Aug. 1, 1950. 51p. (AECU-1726; Report No. 2) (See also NSA 5-3285)

490
Columbia Univ.
POWER RECOVERY AT BROOKHAVEN; by Charles E. Lucke. First draft Sept. 1, 1950. 81p. (AECU-1727; Report No. 3)

RESEARCH PROGRAMS

491
Technical Information Service, AEC
CORPORATE AUTHOR ENTRIES USED IN CATALOGING REPORTS BY TECHNICAL INFORMATION SERVICE, AEC. [nd] (TID-5059)

492
Brookhaven National Lab.
ANNUAL REPORT; JULY 1, 1951. 151p. [nd] (BNL-131)

The progress and trends of the research program at Brookhaven during the fiscal year 1951 are outlined, and the operational services and administrative activities are reviewed. Few details of experiments are given. A list of unclassified publications is included.

493
SOME EXPERIMENTAL WORK CARRIED OUT IN PHYSICS WITH THE LARGER HARWELL PILE. Nature 168, 581-3(1951) Oct.

In experiments with a double-neutron spectrometer, measurements of intensity of reflection of monochromatic neutrons from single crystals showed dependence, for thick crystals, on degree of mosaic spread; relatively large crystals can be used if of the right shape. An asymmetric electron distribution was found to occur in graphite. Studies of effects of pile irradiation showed that some polymers, e.g., cellulose and its derivates and collagen, appear to break down to about the same extent in both the crystalline and noncrystalline regions; others, e.g., nylon and keratin, break down in noncrystalline regions first. Irradiation of an Au-Cu alloy containing 30 at.% Au in its ordered state caused increase of order together with an initial decrease and later increase of electrical resistivity. Transmission of samples of Mo, Br, Zr, Hf, and Se as a function of neutron energy is analyzed with neutron spectrometers. Neutron beams consisting solely of very low-energy neutrons are prepared by filtration by polycrystalline materials. Neutron scattering by polycrystalline samples of Be and Fe was studied by a beam of lead-filtered neutrons. Angular correlation between α particles and γ rays emitted by $B^{10}(n,\alpha)Li^7(\gamma)Li^7$ and between fission fragments and x rays in the slow-neutron fission of U^{235} are reported. B^{10}, and Li^6 were irradiated in a gridded ionization chamber filled with an A-CO_2 mixture; ionization produced by the disintegration particles relative to that of Po α particles was measured. The α spectrum from the breakup of Be^8 following β decay of Li^8 was studied by the gridded ion-chamber technique.

BIOLOGY AND MEDICINE

494
Naval Medical Research Inst., Bethesda
CHEMICAL AND RADIOCHEMICAL STUDIES OF THE DISTRIBUTION OF GALLIUM IN THE ORGANISM; by Horace C. Dudley, John I. Munn, and Katherine E. Henry. Oct. 20, 1949. 12p. (NP-3496)

495
Radiation Lab., Univ. of Calif.
MEDICAL AND HEALTH PHYSICS QUARTERLY REPORT; APRIL, MAY, AND JUNE, 1951. Aug. 14, 1951. Decl. Dec. 5, 1951, 59p. (AECD-3282; UCRL-1437)

Separate abstracts have been prepared on the following sections of this report: The Metabolic Properties of Various Materials, sect.I; and Biological Studies of Radiation Effects, sect.II.

496
Radiation Lab., Univ. of Calif.
THE METABOLIC PROPERTIES OF VARIOUS MATERIALS; sect.I of MEDICAL AND HEALTH PHYSICS QUARTERLY REPORT; APRIL, MAY, AND JUNE, 1951; by J. G. Hamilton. Aug. 14, 1951. Decl. Dec. 5, 1951. 27p. (AECD-3282(sect. I))

Progress is reported in improving the technique of double radioautographs using astatine and radioiodine simultaneously. A representative radioautograph obtained in this experiment from the thyroid gland of a rhesus monkey 18 hr after administration of the two radiohalogens is included and the technique is discussed. Radioautographs made of the livers of rats administered C^{14}-labeled stibamidine is retained by the mitochemical evidence that stibamidine is retained by the mitochondria of the liver cells. Results of tissue-distribution studies showing the fate of Pt, Ir, Hg, Bi, and Rh in rats are presented in tabular form. Chronic toxicity studies to determine the results of long-term feeding of chelating agents were concluded and gross autopsy findings following administration of calcium ethylenediaminetetraacetic acid (CaEDTA) and Fe-3 (a commercial detergent) to rats are reported. Rats injected with Pu^{238} and fed CaEDTA and Fe-3 after 3 months show a seven- to tenfold increase in urinary excretion of Pu in rats fed CaEDTA. Formation of Fe^{59}, $Tl^{201,202}$, $Pt^{191,193}$, and Hg^{197} is reported and procedures are discussed briefly. An all-glass circulating-target assembly is described for irradiation of essentially liter amounts of solution under controlled conditions for use in studies of the detailed mechanism of the indirect action of high-energy radiation on dilu dilute aqueous solutions. A cross section of the circular target pump and schematic drawings showing the arrangement of the target and the complete target assembly are included. Preliminary data using this target assembly for irradiation of acid solutions of ferrous ammonium sulfate saturated with oxygen are given.

497
Radiation Lab., Univ. of Calif.
BIOLOGICAL STUDIES OF RADIATION EFFECTS, sect.II of MEDICAL AND HEALTH PHYSICS QUARTERLY REPORT, APRIL, MAY, AND JUNE, 1951; by J. H. Lawrence. Aug. 14, 1951. Decl. Dec. 5, 1951. 25p. (AECD-3282(sect.II))

To test the macrophage-transport hypothesis of atheromatotis, rabbits were injected with Th^{230}, which had been demonstrated as concentrating in visceral macrophages. After an interval of cholesterol feeding the animals were sacrificed and the distribution of radioactivity between various organs and the atheromatous plaques was studied. The fact that the amount of radioactivity in the plaques was relatively low indicates that macrophage migration is not a significant source of the foam cells in rabbit atherosclerotic lesions. Feeding and distribution data are presented in tabular form, and photographs of histologic sections and radioautographs from tissues of experimental animals are included. An assay of the daily dose of cosmic radiation near the top of the atmosphere was made for a study of radiation hazards in high-altitude aviation. Data are presented in tabular form and discussed briefly. It was demonstrated that heparin administered to rabbits and humans causes profound reorientation in the distribution of low-density lipoproteins, characterized by a shift of lipoproteins of high S_f rates to those of successively lower S_f rates. Heparin administered to cholesterol-fed rabbits prevented the development of high levels of S_f 10-50 lipoproteins and retarded the development of atherosclerosis in such animals. Intermittent heparin administration to patients with severe angina pectoris gave relief from symptoms for periods of several days beyond a single injection. Ultracentrifuge flotation patterns showing the progressive changes in the lipoproteins of a patient with coronary artery disease treated with heparin are included.

498
Utah Univ.
SOME PHOTOCHEMICAL INVESTIGATIONS (abstract); by Henry Eyring, Rufus Lumry, and John D. Spikes. [1951] 3p. (AECU-1738)

Quantitative studies of the "Hill reaction" (light absorption by chlorophyll leading to the production of O_2, electrons, and protons from water) and theoretical studies on energy-transfer mechanisms are being conducted by illuminating isolated chloroplast preparations containing chlorophyll in the presence of electron acceptors (oxidants), as ferricyanide ion and *p*-benzoquinine and by photosynthesis quantum-yield determinations in green plants. Some of the results of these studies are briefly discussed. Two naturally occurring oxidants were found in the same order of concentration as chlorophyll; one found in the cytoplasm of ruptured plant cells may be washed out of the system and seems to function alone in photosynthesis. The other, apparently a permanent constituent of the chloroplast fragments, gives a reversible electrode reaction even though it is not in true solution. Removal of the natural oxidants allowed a study of the factors affecting velocity of the Hill reaction. Most simple inorganic salts in high concentration were found to decrease the efficiency of chard chloroplast materials. Quantum yields in photosynthesis seem to differ with the nature of the natural oxidant available.

499
Minnesota Univ.
FACTORS AND RESULTS IN THE PARTIAL VACUUM INOCULATION OF SEEDLING CORN WITH *USTILAGO ZEAE* (abstract); by J. B. Rowell and J. E. DeVay. [nd] 1p. (AECU-1768)

The report comprises an abstract of a paper for the meeting of the American Phytopathological Society, Dec. 10-12, 1951, and is reproduced here in its entirety.

A partial-vacuum method of inoculating corn seedlings with smut has been tested as a means of quantitatively determining the characteristics of pathogenicity in *Ustilago zeae*. Uniform results required inocula of 10 million cells per milliliter prepared from unicellular, logarithmic phase shake cultures grown on complete media, and aseptic seedlings with coleoptiles 1 cm long which were wounded by a cut at the tip of the leaf sheath. Rate of disease development in planted, inoculated seedlings depended on temperature, galls forming in 10, 14, and 19 days at approximate temperatures of 80, 70, and 60°F, respectively. No differences in disease response to the cross of the haploid lines 17D4 × 10A4 were found in tests of 20 corn lines, crosses, and varieties representing extremes of field resistance and susceptibility. Marked differences in pathogenicity were demonstrated between the haploid cross 17D4 × 10A4 and the two solopathogens 410qq and 410N. The former produced severe stem galls which developed in 92% of the plants within 10 days. The solopathogens produced mostly leaf falls which required 21 days for complete gall development and with only 69 and 49% of the plants infected, respectively, by 410qq and 410N.

500
Argonne National Lab.
QUARTERLY REPORT, FEBRUARY, MARCH, APRIL, 1951; DIVISION OF BIOLOGICAL AND MEDICAL RESEARCH; Austin M. Brues, ed. [nd] 229p. (ANL-4625)

Separate abstracts have been prepared on the following sections of this report: Radiation Sickness, p.14-20, 41-54, 57, 60-3, 125-41, 152-4; Radiation Effects, p.21-40, 56, 58-9, 64-5, 91-8, 164-70, 177-86, 192; Toxicity, p.55, 72-84, 99-124, 142-51, 187-91, 193-4, 209-21; Techniques in the Preparation of Radioactive Glass Beads, p.66-71; On Estimation of Total Radiation Dosage from the Metabolized or Compartmentalized Isotope, p.85-90; Mechanics of Cell Division. I. The Living Spindle, p.155-63; Syntheses, p.171-6; and Measuring Instruments and Techniques, p.195-208.

501
Argonne National Lab.
ON ESTIMATION OF TOTAL RADIATION DOSAGE FROM THE METABOLIZED OR COMPARTMENTALIZED ISOTOPE, p.85-90 of QUARTERLY REPORT, FEBRUARY, MARCH, APRIL, 1951; DIVISION OF BIOLOGICAL AND MEDICAL RESEARCH; by Austin M. Brues. [nd] 6p. (ANL-4625(p.85-90))

Despite the complexity of time-retention curves in a steady-state system of many homogeneous compartments, the integrated dosage from an isotope entering such a system under known external conditions is wholly predictable. It can be computed on the assumption that all the exchangeable isotope in any volume maintains a specific activity × time equal to that in the external compartment. A deviation from this indicates the presence of an irreversible process or deviation from the steady state, or possibly a situation where a diffusion gradient is important. To the extent that a metabolic system satisfies the requirements indicated, the use of "mean retention time" is valid.

These statements have been demonstrated formally for mammillary systems and for catenary systems of two and three compartments in series, and are thought to be generally valid for open linear steady-state systems.

502

Argonne National Lab.

MECHANICS OF CELL DIVISION; I. THE LIVING SPINDLE, p.155-63 of QUARTERLY REPORT, FEBRUARY, MARCH, APRIL, 1951; DIVISION OF BIOLOGICAL AND MEDICAL RESEARCH; by T. N. Tahmisian. [nd] 9p. (ANL-4625 (p.155-63))

The fact that damage to the cell spindle precedes chromosomal dissolution led to the investigation of the possibility of observing the living spindle. Twelve separate stages of the spindle have been photographed in various phases of mitosis. The cells used were those of the grasshopper testes in a special nutrient saline solution at pH 6.8 having a freezing point lowering of 0.520°C. Cells treated with colchicine 24 hr earlier showed no spindles; however, if colchicine was added after the spindle was formed, dissolution of the spindle did not occur. When a portion of the spindle was lost, chromosomes on that side of the cell became pycnotic, while those still attached to the remaining spindle were not affected. It is believed that the spindle maintains chromosomal integrity during cell division. 33 figures.

503

Brookhaven National Lab.

THE UPTAKE AND DISTRIBUTION OF BARIUM^{140} AND LANTHANUM^{140} IN LARVAE OF DROSOPHILA REPLETA; by Vaughan T. Bowen. [nd] 26p. (BNL-1018)

The barium metabolism of Drosophila repleta larvae, studied by use of radioactive Ba^{140}, is described as involving uptake from the anterior part of the mid-gut, and to a less extent from the bases of the caecae. The absorbed material is rapidly transferred to the lumen of the ascending portions of the anterior malpighian tubules, where it is stored in a somewhat soluble form, until after pupation. Smaller amounts of the element appear in scattered patches of cells of the posterior mid-gut, and some is excreted from the anterior malpighian tubules. Lanthanum^{140} is not found to be absorbed by D. repleta larvae, nor does it appear to be excreted when formed in the body by decay of Ba^{140}. The observation is made that material may be held for 10 to 20 hr in the space between the peritrophic membrane and the anterior mid-gut epithelium. Partition of foodstuff between this slow-moving stream and the rapidly moving contents of the peritrophic membrane is seen to be of great importance in determining efficiency of absorption by the larvae. It is concluded that the location of barium uptake indicates a functional localization of treatment of dissolved as opposed to particulate food, and not a localization of uptake of a particular ion or ions. (auth)

504

Tennessee Univ.

QUARTERLY PROGRESS AND WORK ACCOMPLISHMENT REPORT FOR QUARTER ENDING SEPTEMBER 30, 1951. [nd] 33p. (ORO-54)

Progress is reported in the study of the fission-products metabolism in domestic animals and the dependence of their behavior upon normal mineral metabolism. Blood-volume values for swine were determined using the P^{32}-labeled red-cell method. Swine with average body weight of 10 lb were found to average 7.4 ml of blood per 100 g body weight, while those averaging 344-lb body weight had 4.6 ml of blood per 100 g body weight. Values for intermediate body-weight groups are also included. Blood values for the southwestern burro (Equus asinus asinus) were determined and are presented in tabular form. The multicurie irradiation field for large animals was loaded, calibrated, and placed in operation. Normal blood values for the healthy burro have been established to serve as a basis for following the changes caused by irradiation. Particular attention is invited to the results of a preliminary experiment on the effects of whole-body irradiation upon the subsequent fertility of the male rabbit. These data emphasize the fact that observations on the sperm themselves or even on the initial fertilization do not suffice to give a true measure of irradiation effects on fertility; it is necessary, therefore, to use the number of viable young produced as the criterion. As an indication of results, it was shown that while control rabbits in 34 matings produced an average of 6.56 viable young per mating, the values for males exposed to 100, 200, and 300 r were 3.4 in 15 matings, 4.5 in 26 matings, and 3.2 in 16 matings, respectively.

RADIATION EFFECTS

505

[Los Alamos Scientific Lab.]

EXPERIMENTAL RADIATION CATARACTS; II. CATARACTS IN THE RABBIT FOLLOWING SINGLE EXPOSURE TO FAST NEUTRONS; by David G. Cogan, John L. Goff, and Elizabeth Graves. [nd] 23p. (AECU-1743)

The production of radiation cataracts and other ocular effects in rabbits has been studied using single exposures to relatively pure neutron sources of 14 Mev and fission energy. The course of events following neutron radiation is basically similar to that following x-ray exposures, and comparable effectivity as regards cataracts is obtained with 5×10^{10} neutrons/cm^2 (14 Mev) or with 9×10^{10}. neutrons/cm^2 (fission energy) as was obtained with 500 r (1.2 Mev). While the morphologic changes in the lenses with neutrons and x rays showed the same differences when heavy and light doses were used, neutron radiation with 14 Mev produced more of the transient vacuoles than did the x-ray radiation or the fission neutron radiation. The threshold dose for cataract production by neutrons is less than 2×10^9 neutrons/cm^2 incident on the lens. (auth)

506

Argonne National Lab.

RADIATION EFFECTS, p.21-40, 56, 58-9, 64-5, 91-8, 164-70, 177-86, 192 of QUARTERLY REPORT, FEBRUARY, MARCH, APRIL, 1951; DIVISION OF BIOLOGICAL AND MEDICAL RESEARCH; Austin M. Brues, ed. [nd] 51p. (ANL-4625(p.21-40, 56, 58-9, 64-5, 91-8, 164-70, 177-86, 192))

Survival data are presented for two strains of mice, C$_3$Hb (without the milk agent) and the hairless strain, given a single whole-body 400-r x irradiation within 12 hr after birth or chronic γ irradiation of 4.4 or 8.8 r (8 hr) beginning at age 1 month. Survival data on mice (progeny of crosses between C$_3$H and C-57 black strains) exposed 6 to 12 hr after birth to x irradiation of the head alone indicate a 20-day LD$_{50}$ of 1000 to 1100 r; observations on rate of hair growth, age at which eyes opened, and formation of cataracts are reported; examination of the eyes by ophthalmoscope is recommended for early recognition and study of cataracts. Some preliminary data on the plasma electrolyte balance in dogs receiving a single total-body x-ray exposure of 450 r are given. The binding of organic ions by bovine serum albumin x radiated with 1000 to 120,000 r has been investigated; the binding energy decreases with increasing x-ray dosage above 10,000 r. The dosage rate required to reduce mitotic frequency below 50% in regenerating rat liver and Hall mouse carcinoma is given as a function of distance from 2 to 200 μc Sr^{90}– Y^{90} beads; effects of the β radiation on tumor cells are illustrated. Incidence and microscopic appearance of tumors induced in female Sprague-Dawley rats by β radiation on the dorsal skin from point and diffuse sources of Sr^{90} are shown. The comparative and additive physiological and genetic effects of x radiation and nitrogen mustards on Paramecium aurelia, and the action of infrared, visible, ultraviolet, and x rays on the mating reaction in Paramecium bursaria, are being investigated. Some data are given on the effect of x rays on the metabolism of haploid and diploid yeasts, and on the oxidation of dihydrodiphosphopyridine nucleotide ($DPNH_2$) by x rays.

507
Brookhaven National Lab.
SURVIVAL OF RATS ADRENALECTOMIZED AFTER X-IRRADIATION; by Abraham Edelmann and Seymour Katsh. [nd] 9p. (BNL-1019)

An abstract of this report was issued and indexed as Report AECU-1137 and appears in its entirety in Nuclear Science Abstracts as NSA 5-2317.

508
Atomic Energy Project, Univ. of Calif.
PAPER CHROMATOGRAPHIC STUDY OF FREE AMINO ACIDS OF YOLK OF DEVELOPING NORMAL AND X-IRRADIATED CHICK EMBRYOS; by Richard F. Riley and Esther Richter. Nov. 26, 1951. 8p. (UCLA-171)

The free amino acids of yolk of fertile chick embryos between the 5th and 20th day were examined by paper chromatography after removal of proteins by alcohol precipitation and lipids by petroleum ether and ethyl ether extraction. α-Alanine, arginine, glutamic acid, glutamine, leucine(s), lysine, and tyrosine were found consistently, and cysteic acid, glycine, methionine, proline, and serine, threonine, and valine were also found in most extracts. Appreciable amounts of peptides were absent. 500 r of x irradiation ($\sim LD_{50}$) administered on the 10th day did not alter this picture appreciably. (auth)

509
Atomic Energy Project, Univ. of Rochester
QUARTERLY TECHNICAL REPORT JULY 1, 1951, THRU SEPTEMBER 30, 1951; Henry A. Blair, Director. Oct. 25, 1951. 76p. (UR-189)

Separate abstracts have been prepared on the following sections of this report: Radium Toxicity and External Radiation—Biological Effects, p.6-45; External Radiation—Tolerance and Therapy, p.46-55; and Instruments—Research and Development, p.56-73.

510
Atomic Energy Project, Univ. of Rochester
RADIUM TOXICITY AND EXTERNAL RADIATION—BIOLOGICAL EFFECTS, p. 6-45 of QUARTERLY TECHNICAL REPORT JULY 1, 1951, THRU SEPTEMBER 30, 1951; Henry A. Blair, Director. Oct. 25, 1951. 40p. (UR-189(p.6-45))

Radium analysis of municipal water supplies of 33 cities, comprising about 20% of the population of the United States, is presented in tabular form. Results of a study of the differential leukocyte count of an Indian elephant presented in table form and discussed briefly. Serum, sodium, potassium, chloride, and carbon dioxide content were determined serially on dogs receiving single massive whole-body exposures to x rays. Sodium, potassium, and chloride were also studied by a balance technique. Results give rise to preliminary conclusions that the slight, but probably real, electrolyte changes in dogs following single massive whole-body exposures to x rays are in keeping with changes known to occur as a result of dehydration and starvation and are probably attributable to these factors. Preliminary observations of the effects of radiation on the metabolic process in baker's yeast confirm previously published data showing complete inhibition of colony formation without inhibition of over-all metabolism following irradiation with 20,000-r 250-kv x rays. Using 90,000-r air dose, of 250-kv x rays, a small but constant stimulation of both oxygen uptake and anaerobic CO_2 production was observed. Rate of uptake of glucose by the cells was not slowed up by an x-ray dose almost five times that sufficient to produce complete inhibition of colony formation. Results are presented by graphs and tables, accompanied by a brief discussion. A feasible method for the degradation of porphyrins of the protoporphyrin IX type is described. Urinary and serum fibrinolytic activity was measured in dogs after 450 to 700 r of whole-body radiation. Three or four days before death both the urine and serum fibrinolytic activity increased significantly, reaching maximum values just before death. The relation between the enhanced fibrinolytic enzyme activity and the hemorrhagic lesions noted at autopsy is discussed.

511
EFFECT OF IONIZING RADIATIONS ON VITAMIN B_{12}. P. C. Markakis, S. A. Goldblith, and B. E. Proctor. Nucleonics 9, No. 6, 71-82(1951) Dec.

The effects of ionizing radiations on vitamin B_{12} in pure solution and in raw whole milk were studied. In both cases the vitamin B_{12} was found to be relatively radiosensitive and the effect of the radiation was considered to be indirect.

512
METHOD FOR DETERMINING RELATIVE DOSAGE OF BIOLOGICAL SAMPLES. Gustave Joyet. Nucleonics 9, No. 6, 42-9(1951) Dec.

Standardized incineration to obtain similar ashed samples is suggested in this method for attaining uniformity in counting samples of biological tissues and liquids. Temperature sensitivity of G-M counters and some problems of self-absorption are also considered. (auth)

RADIATION HAZARDS AND PROTECTION

513
Hanford Works
RADIOACTIVE PLANKTON FROM THE COLUMBIA RIVER; by R. W. Coopey. Mar. 29, 1951. 21p. (HW-20668)

Plankton collections and limnological chemical tests made from the Columbia River above and below the Hanford Works production area from Feb. 1949 to Feb. 1950 show no significant influence on characteristics of the river, due to the plant operations. Activity-density measurements at Hanford show a maximum plankton value of $7.9 \times 10^{-3} \mu c/g$ wet weight during Jan. 1950, the highest activity being found during minimal flow periods in the winter season. Gravimetric analysis shows 1200 mg of wet weight plankton per cubic meter of river water at maximum. Plankton being carried by the river past Hanford is estimated at 5.2×10^5 kg (570 tons) per day during May, and while the radioactivity it contained averaged 0.6 c per day in July. Decay curves indicate 5 to 30% of the activity results from isotopes with half lives near or longer than that of P^{32} while the remaining major portion is of shorter half-life material. A small proportion of activity persists after 600 days' decay.

514
[Atomic Energy Research Establishment, Harwell, Berks (England)]
SAFETY HANDBOOK; by J. D. Cockcroft. [nd] 65p. (NP-3527)

This is the industrial safety handbook issued to employees at AERE. Codes of practice in general and in many specific instances are outlined. The booklet is divided into the following sections: Radioactivity and its control; Safe Handling of Chemicals; Types and Applications of Breathing

Apparatus Available at Harwell; Safe Handling of Liquefied Gases; Safe Handling of Sodium, Potassium, and Related Alloys; Safe Use of Lifting Machines and Tackle; Avoidance of Electrical Accidents; Safe Use of Ladders; Installation and Maintenance of Bursting Discs; Entry Into Confined Spaces, etc.; Installation and Maintenance of Pressure Gauges; and Pressure Vessels.

515

Sedgwick Labs. of Sanitary Science, Mass. Inst. of Tech.
THE REMOVAL OF RADIOACTIVE ANIONS BY WATER TREATMENT; by Warren J. Kaufman, John B. Nesbitt, Morton I. Goldman, and Rolf Eliassen. Sept. 20, 1951. 143p. (NYO-1571)

The effectiveness of conventional water-treatment processes in the removal of minute quantities of anionic radioisotopic contaminants has been considered, with detailed studies limited to the removal characteristics of P^{32} as the orthophosphate and I^{131} as the iodide. Possible future sources of radioactive contamination are considered. The mechanism of incorporation of small quantities of orthophosphate into the hydrous oxide precipitates formed from alum and ferric sulfate and the influence of various normal constituents of surface water on the removal of phosphate by coagulation has been investigated. The removal of phosphate and iodide from three typical synthetic United States waters was carried out in coagulation-jar and pilot-plant experiments. The important elements of a rapid sand filtration plant were found to be the reaction and coagulation units. The direct adsorptive capacity of clean filter sand was found to be negligible. The removal of iodide was not successful with any of the conventional water-coagulation processes.

516

Atomic Energy Project, Univ. of Rochester
EXTERNAL RADIATION—TOLERANCE AND THERAPY, p. 46-55 of QUARTERLY TECHNICAL REPORT JULY 1, 1951, THRU SEPTEMBER 30, 1951; Henry A. Blair, Director. Oct. 25, 1951. 10p. (UR-189(p.46-55))

From an investigation of the effect of spleen shielding on x-irradiation mortality in dogs it is concluded that lead shielding of the exteriorized spleen during x irradiation is an effective means of reducing mortality. Preliminary hematological studies based upon peripheral white-blood-cell counts and hematocrits also indicate an early recovery of the hematopoietic tissue in spleen-shielded dogs. A preliminary report of a study of the effect of aureomycin and whole blood, singly and in combination, on x-irradiated dogs shows the group treated with aureomycin and whole blood to have a lower mortality rate than those treated only with blood or aureomycin. An increased incidence of severe pulmonary hemorrhage in the groups receiving blood transfusions appeared to be significant.

517

THE INERTIAL MECHANISM IN THE MECHANICAL FILTRATION OF AEROSOLS. Eugene A. Ramskill and Wendell L. Anderson. J. Colloid Sci. 6, 416-28(1951) Oct.

The role of inertial mechanism in mechanical filtration of aerosols of 0.2 to 1 diameter particle size range is shown. The manner in which the inertial effect enters into the filtration mechanism can be expressed by the equations $K_p d_e = 2r\rho v_p/9\eta$, $K_m d_e = 2r^2\rho v_m/9\eta$, where K_p and K_m are constants, d_e is the effective fiber diameter, r is the particle radius, ρ is the particle density, v_p is the velocity at which the inertial effect becomes measurable (penetration starts to decrease with increasing velocity), v_m is the velocity above which no additional inertial effect occurs, and η is the viscosity of the gaseous medium. Tentative value for the constants K_p and K_m have been determined experimentally. Calculated values of d_e for various filters are shown to be either direct measures of the actual fiber diameter (d_f), the interfiber distance (d_i), or some function of the two depending on the method of formation of the filter. The general structure of a complete three-dimensional filtration diagram for a given filter is indicated. The inertial effect is proposed as the reason that no maximum occurs in the penetration-radius curve in the predicted size range.

518

A COMPLETE WASTE-DISPOSAL SYSTEM FOR A RADIOCHEMICAL LABORATORY. Walton A. Rodger and Phillip Fineman. Nucleonics 9, No. 6, 51-61(1951) Dec.

The operation of the disposal system installed at ANL for the control of radioactive effluents is described. The variety of methods used to handle the wastes is shown on a flowsheet. Particular attention is given to the method for treating the contaminated gases that are involved in chemical, metallurgical, and biological operations. The system devised to solve the problems for treating contaminated liquids is by far the most complex.

519

ESTIMATES ON THE CONCENTRATION OF RADIOIODINE IN SEWAGE AND SLUDGE FROM HOSPITAL WASTES. C. C. Ruchhoft and Sergei Feitelberg. Nucleonics 9, No. 6, 29-34(1951) Dec.

A study of the concentration of I^{131} and P^{32} in the municipal sewerage of six large American cities resulting from the use of these isotopes for human therapy is presented. The results indicate that the probability seems remote that any one hospital will discharge regularly as much as 200 mc of waste per day into the sewage. At this rate, the dilution needed to reduce the activity to safe limits is no major problem.

RADIATION SICKNESS

520

Argonne National Lab.
RADIATION SICKNESS, p.14-20, 41-54, 57, 60-3, 125-41, 152-4 of QUARTERLY REPORT, FEBRUARY, MARCH, APRIL, 1951; DIVISION OF BIOLOGICAL AND MEDICAL RESEARCH; Austin M. Brues, ed. [nd] 46p. (ANL-4625 (p.14-20, 41-54, 57, 60-3, 125-41, 152-4))

Survival was enhanced significantly in groups of LAF_1 mice injected intravenously or intraperitoneally with bone-marrow suspensions within 10 to 15 min following a single total-body exposure to 900 r of x radiation. Spleen brei injections did not afford any protection. Only a small amount of bone marrow (1.5 mg) gave nearly complete protection. Data on survival and hemopoietic recovery of mice exposed to a 1025-r total-body x irradiation with protection of the spleen and other organs and of spleen-shielded mice exposed to repeated 1025-r doses are tabulated. Peritoneal implantation of four spleens from baby mice enhanced survival of previously 1025-r x-irradiated mice, whereas a two-spleen implant had no effect. Leaving a blood vessel at the distal tip of the spleen unsevered during exteriorization and shielding greatly enhanced survival. Intraperitoneal injection of minced mouse embryos following a 1025-r x irradiation resulted in ~35% survival of mice. Combinations of spleen shielding, cysteine, and estrogen resulted in an enhancement of survival greater than the sum of individual protective values. Additional data indicating the failure of postirradiation cysteine and ascorbic acid treatment to influence radiation mortality are given. The beneficial effect of head shielding on survival of dogs exposed to 450 r of x radiation are shown. The effect of cyanide in increasing the radiosensitivity of mouse tumor fragments was not obtained in the absence of O_2 and was not caused by destruction of tumor cells. Young rats were implanted subcutaneously with the Hall mouse carcinoma 1 to 2 hr after 100-, 200-, or 300-r total-body x irradiation; organ weight and histological studies show that a growing heterologous tumor is able to evoke significant hyperplasia of proximal lymph nodes and spleen in counteraction of the effect of irradiation; in reduction of the thymus, tumor and radiation have an additive effect. Administration to 2- to 4-day chicks of 25 mg/kg of Benemid immediately prior to a 1000-r x irradiation did not increase survival or alter renal function.

RADIOGRAPHY

521

Radiation Lab., Univ. of Calif.
FLUORESCENT CRYSTAL COUNTING IN MEDICAL TRACER RESEARCH (abstract); by H. O. Anger. Nov. 1951. 1p. (UCRL-1579)

The report comprises an abstract of a paper for the 4th Annual Conference on Electronic Instrumentation in Nucleonics and Medicine at New York, Jan. 7, 1952, and is reproduced here in its entirety.

A scintillation-type gamma counter for liquid or solid samples is described. It consists of an RCA 5819 phototube with a thallium-activated sodium iodide crystal in the shape of an annular ring. The γ-ray counting efficiencies for 2-ml liquid samples are about equal to those obtained from a thin-window G-M counter when β particles from thin samples are counted. When the counter is heavily shielded, the background is about 160 cpm. A plateau is obtained in the counting-rate vs. operating-voltage curve. A directional γ ray which is being used for in vivo counting of I^{131} and Fe^{59} is described. A γ-ray pinhole camera has been constructed with which an image has been obtained of a tumor in a patient treated with 100 mc of I^{131}. A 1-hr exposure was required. The image was recorded by a photographic plate in contact with an intensifying screen consisting of a large, flat NaI(Tl) crystal.

522

THE PARALLAX-PERSPECTIVE METHOD FOR ROENTGENOLOGICAL DEPTH DETERMINATION. H. Bumiller. Fortschr. Gebiete Röntgenstrahlen 75, 481-5(1951) Oct. (In German)

An x-ray-photography method for exact depth determinations without need of special equipment is described. A wire of known length is laid on the skin at a measured distance from the film, roughly above the foreign body to be photographed. Two pictures are taken on the same plate, the x-ray tube being moved horizontally before the second picture is taken. Formulas are given using the correlation of displacements of the extreme ends of the wire image and the foreign-body image on the plate for depth determination.

RADIOTHERAPY

523

USE OF RADIOACTIVE IODINE IN THE STUDY AND TREATMENT OF DISEASES OF THE THYROID GLAND. A. Querido. Bruxelles-méd. 31, 2463-7(1951) Nov. 25. (In French)

Use of radioactive I for diagnostic and therapeutic purposes is described. Amount and rate of I accumulation in the gland and excretion of I in the urine are measured.

524

INDICATIONS OF RADIOACTIVE EFFECTS IN MINERAL BATHS. M. Milhaud. Bruxelles-méd. 31, 2468-75(1951) Nov. 25. (In French)

The therapeutic effectiveness, in a number of diseases, of certain radioactive mineral baths is discussed.

525

MEASUREMENT AND HANDLING OF RADIOACTIVE MATERIALS FOR THERAPEUTIC USE. W. K. Sinclair. Nucleonics 9, No. 6, 35-42(1951) Dec.

Limitations imposed by the available techniques hamper accurate measurement of radioisotopes used therapeutically. A British hospital has adopted standardized instrumentation to surmount this difficulty. Handling equipment and methods adapted to the particular therapeutic use are described. (auth)

TOXICOLOGY STUDIES

526

Argonne National Lab.
TOXICITY, p.55, 72-84, 99-124, 142-51, 187-91, 193-4, 209-21 of QUARTERLY REPORT, FEBRUARY, MARCH, APRIL, 1951; DIVISION OF BIOLOGICAL AND MEDICAL RESEARCH; Austin M. Brues, ed. [nd] 70p. (ANL-4625(p.55, 72-84, 99-124, 142-51, 187-91, 193-4, 209-21))

Radioautographic studies of the distribution of Ra in trabecular and cortical bone of the tibia and fibula of a human 25 yr following Ra ingestion, distribution of Ca^{245} in rat bone, and distribution of Ra and Pu^{239} in dog bone are presented. Studies of the fate of C^{14} absorbed by mice and rats during a 30- to 60-min period of exposure to $C^{14}O_2$ have been made. The calculated rates of passage of alveolar CO_2 into the blood were 23 μ moles/min in the mouse and 160 μ moles/min in the rat. Uptake of C^{14} was essentially unaffected by the CO_2 concentration of inhaled air. Passage of C^{14} from the bicarbonate compartments into inner compartments proceeded at a somewhat slower rate. Rates of uptake of C^{14} from $C^{14}O_2$ by the livers of adult and newborn mice are compared, and the bone carbonate turnovers of adult mice and rats are discussed. The toxicity ratio between Ra and Pu has been evaluated from the data of a large number of experiments. The best available Ra/Pu ratios, in terms of injected μc/kg are: acute toxicity to small animals, 15; chronic survival, 10; formation of bone tumors in rats and mice, 15; formation of bone tumors in rabbits, 8; and bone fractures in rats and rabbits, about 10. A maximum permissible retained dose of 0.04 μc of Pu in man is the best value available from present biological information. The median lethal dosage to rats of H^3O_2 administered continuously over a 2-month period corresponds to between 57 and 77 rep/day on the basis of dosage rate in body water. The mean accumulated dosages to death are between 3000 and 3700 rep, being consistently higher at 77 than at 96 rep/day. The effectiveness in protecting against Be poisoning of various dyestuffs having structural similarity to aurin tricarboxylic acid was tested with negative results. The acute toxicities of members of the mesothorium chain (Ra^{224}, Th^{228}, Ra^{228}-Ra^{226}-Po^{210} equilibrium mixture, and Ra^{224}-Th^{228} equilibrium mixture) have been studied in CF-1 female mice. The 20- to 30-day LD_{50}'s for all the elements except Ra^{226} fall between 36 and 58 μc/kg. The Ra^{226} values range from 830 to 1100 μc/kg.

527

Naval Medical Research Inst., Bethesda
EFFECTS OF INJECTION OF RADIOGALLIUM (Ga^{72}); by H. C. Dudley, L. J. Louviere, and J. C. Shaw. Sept. 15, 1951. 11p. (NP-3509)

Radiogallium (Ga^{72}) citrate has been administered to five species of animals. The toxicity of the carrier gallium limits the radiation dosage of Ga^{72} so that the only effect of radiation observed was transitory reduction of leucocytes. A reduction of total leucocytes in the mouse, rabbit, and guinea pig have been produced at dosages of 2.3 to 9.0 mc of

Ga^{72}/kg. The degree and duration of the leukopenia varies with the dose and species. Repeated injection of dogs and rabbits with gallium citrate indicates that this element is a cumulative poison for which these species cannot develop a tolerance. Subacute doses repeated twice weekly produced lethal results within four weeks. The final injection produced the typical results of an acutely toxic dose. In the dog, repeated injections of gallium citrate produced an exfoliating dermatitis which may appear several weeks after stoppage of the injections. Methods for the estimation of both total body radiation and individual tissue dose, as delivered by Ga^{72} citrate, are given. Total body irradiation (in roentgens) for man is estimated to be $D_{(\beta+\gamma)}$ = 86 mc of Ga^{72}/ kg of body weight. (auth)

528

Atomic Energy Project, Univ. of Rochester
ACUTE TOXICITY OF INHALED THORIUM COMPOUNDS; by Robert H. Hall, Catherine A. Stroud, James K. Scott, Robert E. Root, Luville T. Steadman, and Herbert E. Stokinger. Nov. 13, 1951. 25p. (UR-190)

The low toxicities of $Th(NO_3)_4.4H_2O$, ThO_2, ThF_4, and Th oxalate have been demonstrated by a series of tests in which animals breathed atmospheres containing these as dusts. The species exposed were dogs, rabbits, guinea pigs, rats, mice, and hamsters. Negative findings were reported for mortality, urinary protein, blood NPN and urea, plasma fibrinogen, and serum protein. Growth depression was observed in rats exposed to ThO_2. Occasional vomiting was observed in the dogs exposed to the nitrate. A thorough histological examination revealed practically no pathological changes attributed to the treatment; the exceptions were minor lesions of uncertain etiology in the lungs. The only positive findings were changes in the hematological picture, especially in the white cells, and somewhat abnormal bone marrow. Spectrographic analyses of the Th content of lung, femur, liver, and spleen showed a tendency for increased Th content with increased exposure.

TRACER APPLICATIONS

529

Michigan State Coll.
THE REDISTRIBUTION OF RADIOCALCUIM AND RADIOIODINE DURING HISTAMINE SHOCK; by Marvin Murray, W. Doyne Collings, and Lester F. Wolterink. 15p. [nd] (AECU-1732)

Normal guinea pigs and guinea pigs injected subcutaneously with $Ca^{45}Cl_2$ or I^{131} received a lethal dose of histamine acid phosphate (0.4 mg of histamine base per kg body weight). Intra- and extracellular distribution of both electrolytes was investigated under normal and under histamine shock conditions. During shock, I space decreased in liver and striated muscle, and increased slightly in lung and urinary bladder; Ca space expanded in liver 350%, in striated muscle 700%, and increased slightly in lung and urinary bladder. The quantity of Ca immobilized is sufficiently large to necessitate entrance into the extracellular space, possibly from the skeletal Ca reservoir.

530

Connecticut Agricultural Experiment Station
EFFECT OF STUNTING AGENTS, FUSARIUM LYCOPERSICI (FL) AND MALEIC HYDRAZIDE (MH), UPON PHOSPHORUS DISTRIBUTION IN TOMATO; by Paul E. Waggoner and A. E. Dimond. [nd] 1p. (AECU-1752)

Distributions of P^{32} in normal tomato plants and plants inoculated with FL and/or sprayed with 0.1% MH solution were compared 2 weeks after inoculation and treatment. One and 3 days before observation, P^{32} was applied to sand in which the plants were growing. MH alone did not cause vascular discoloration, reduced plant weights to one-sixth of check weights, and lowered P^{32} content of stems and, especially, of leaves and growing points. FL alone caused vascular discoloration, reduced plant weights to one-half, and did not significantly alter amount or distribution of P^{32}. Vascular discoloration was increased in inoculated plants whose phosphorus contents were decreased by treatment with MH. MH is inferred to stunt by suppressing metabolism and, hence, phosphorus content. In contrast, FL is inferred to stunt by consuming food and nutrients and by producing toxins. Consequently, metabolism and phosphorus content of combined host and parasite are not suppressed. These inferences lead to a mathematical model relating quantity of FL and phosphorus to growth of host. The model is consistent with other facts concerning FL behavior.

531

Radiation Lab., Univ. of Calif.
THE PATH OF CARBON IN PHOTOSYNTHESIS; XIII. pH EFFECTS IN $C^{14}O_2$ FIXATION BY SCENEDESMUS; by C. Ouellet and A. A. Benson. Oct. 23, 1951. 15p. (UCRL-1510)

The rates of photosynthesis and dark fixation of $C^{14}O_2$ in Scenedesmus have been compared in dilute phosphate buffers of 1.6 to 11.4 pH; determination of C^{14} incorporation into the various products shows enhancement of uptake in an acid medium into sucrose, polysaccharides, alanine and serine, and in an alkaline medium into malic and asparctic acids. Kinetic experiments at extreme pH values suggest that several paths are available for CO_2 assimilation. A tentative correlation of the results with the pH optima of some enzymes and resultant effects upon concentrations of intermediates are presented.

532

OXIDATIVE FORMATION OF LACTIC ACID BY FUNGUS. S. F. Carson, J. W. Foster, W. E. Jefferson, E. F. Phares, and D. S. Anthony. Arch. Biochem. 33, 448-58(1951) Oct.

Experimental evidence has been presented for an aerobic biosynthesis of lactate from a C_2 precursor. The data indicate that the C_4-dicarboxylic acids function as intermediates; oxygen is essential. The aerobic process occurs concomitantly with glycolytic lactate synthesis and accounts for the extra lactate yield under vigorously aerobic conditions. A scheme is presented which accounts for the observed facts and it is evident that the oxidative synthesis of lactate in reality involves an oxidative synthesis of pyruvate. This latter synthesis is discussed from the point of view of its importance to autotrophic organisms, which must of necessity synthesize the important intermediate, pyruvate, from carbon fragments consisting of two carbons or less.

CHEMISTRY

533
[Oak Ridge National Lab.]
PRODUCTION OF PURIFIED ANTHRACENE AND CLEAR ANTHRACENE CRYSTALS; by P. R. Bell, Jr. [nd] 3p. (AECU-1728)

Anthracene is extracted from commercial brands by acetone, resublimed, and, after final filtering, dissolved in boiling benzene. On rapid cooling, the anthracene crystallizes and is filtered out. This purified anthracene is heated at 220 to 230° until all is melted and is then allowed to solidify slowly. The crystals are quite brittle; they may be split into sheets and are strongly double refracting.

534
Utah Univ.
STOICHIOMETRY OF THE REACTIONS INVOLVED IN THE EVOLUTION OF OXYGEN BY ISOLATED CHLOROPLASTS UPON ILLUMINATION (abstract); by John D. Spikes. [1951] 1p. (AECU-1737)

The report comprises an abstract of a paper presented at the meeting of the American Society of Plant Physiologists, Los Angeles, June 19-22, 1951, and is reproduced here in its entirety.

The balanced equation for the evolution of oxygen gas by isolated chloroplasts upon illumination when potassium ferricyanide is added as oxidant is usually given as follows:

$$4K_3Fe(CN)_6 + 4K^+ + 2H_2O \rightarrow 4K_4Fe(CN)_6 + 4H^+ + O_2$$

The stoichiometry indicated has been based largely on "before and after" determinations. In the present work this relationship has been investigated continuously during the course of the reaction. Warburg vessels provided with platinum, calomel, and glass electrodes were constructed. With these the oxygen evolution, pH, and oxidation-reduction potential of the reaction system could be measured either continuously or at frequent intervals. It was found that the stoichiometric relations indicated above were precisely followed during the entire course of the reaction. This work has been extended to include the study of other added oxidants.

535
College of Sciences and Arts, State Coll. of Wash.
THE FORMULAE AND STABILITY OF COMPLEX IONS IN SOLUTION; APRIL 1, 1950–APRIL 1, 1951; by H. W. Dodgen. Apr. 1, 1951. 5p. (AECU-1741)

Results obtained during this report period on the equilibrium constants of the fluoride complexes of Fe(III), Be, In, Mg, and Al ions and on the chloride and bromide complexes of Cu(II) ion are summarized very briefly. During development of a method for counting radioactive Tl it was found that precipitate mounting and cathodic deposition were unsuccessful; anodic deposition showed promise, but counting the solution directly was more rapid and accurate.

536
Wisconsin Univ.
THE PREPARATION OF Li^6 TARGETS; by Fay Ajzenberg. [nd] 4p. (AECU-1748)

Thin layers of pure Li^6 metal for use as targets were made from Li^6-enriched Li_2SO_4 by the following procedure: The Li_2SO_4 was converted to LiCl by reaction with $BaCl_2$ in aqueous solution. Dry LiCl was dissolved in very pure pyridine and deposited electrolytically on a cathode of the desired target backing material. The targets were stored in dry benzene or dry xylene to prevent oxidation.

537
Illinois Univ.
DIFFUSION THROUGH AN INTERFACE; BINARY SYSTEM; by L. H. Tung and H. G. Drickamer. [nd] 18p. (AECU-1769)

Diffusion measurements have been made for the system SO_2–*n*-heptane at 0 and 15°C under a pressure of 6.8 atm. of N_2. Measurements were made between saturated hydrocarbon layers, between saturated SO_2 layers, and between the saturated SO_2 and the saturated hydrocarbon layers, using $S^{35}O_2$ as tracer. The results are analyzed according to a phenomenological theory (Scott, Tung, and Drickamer, *J. Chem. Phys.*, in press). The resistance in the interface is significant compared with the resistance to ordinary diffusion, even within 4°C of the critical solution temperature.

538
Pennsylvania State Coll.
POLAROGRAPHIC BEHAVIOR OF ORGANIC COMPOUNDS; XI. THE *ALPHA*-BROMO-*n*-ALKANOIC ACIDS; by Isadore Rosenthal, Charles H. Albright, and Philip J. Elving. Aug. 30, 1951. 23p. (NYO-798)

A polarographic study of the saturated straight-chain α-bromoalkanoic acids from acetic to caprylic inclusive, indicates an initially similar pattern of behavior for all involving the fission of the carbon-halogen bond and the conversion to the corresponding acid. As the chain length increases, the ease of reduction increases at all pH values, with the one exception that the bromopropionic acid in the alkaline region is more difficultly reducible than the bromobutyric acid. Maxima effects [found with the acids] can apparently be ascribed to the colloidal behavior of the acids upon dilution with buffers in which the reducible acid has a lower solubility than in pure water. The effects of ethanol on half-wave potential and diffusion current have been investigated with representative members of the series. In the alkaline region $E_{1/2}$ increases and i_d decreases as the alcohol content increases. The evidence in the acid region, though not entirely conclusive, indicates the reverse effect with regard to half-wave potential. (auth)

539
Ames Lab.
SPECTROPHOTOMETRIC INVESTIGATIONS OF SOME COMPLEXES OF RUTHENIUM; I. THE RUTHENIUM-THIOCYANATE SYSTEM; by Ruth Powers Yaffe and Adolf F. Voigt. Dec. 4, 1951. 15p. (ISC-185)

The ruthenium(IV)-thiocyanate system has been studied spectrophotometrically. It was found that both Ru(III) and Ru(IV) form the same deep-blue complex, with a formula $Ru(CNS)_1^{++}$, and a stability constant of 60 ± 1, at unit ionic strength. A method of interpretation of spectrophotometric data, applicable to one complex of low stability, was developed. (auth)

540
Utah Univ.
OXIDATION-REDUCTION POTENTIALS IN PHOTOSYNTHESIS (abstract); by Rufus Lumry and John Spikes. [1951] 2p. (AECU-1739)

The report is reproduced here in its entirety.

It is now generally concluded that the chlorophyll-containing plant materials responsible for the Hill reaction,

$$X\ (\text{oxidized}) + H_2O \xrightarrow[\text{chloroplast fragments}]{h\gamma} X\ (\text{reduced}) + H^+ + O_2$$

correspond closely to the oxygen-evolving system of photosynthesizing plants and algae. Reaction velocity has been determined potentiometrically using ferricyanide as oxidant (X). The technique originated by Spikes, Lumry, Eyring, and Wayrynen has been improved and correlated with oxygen-evolution methods. Chloroplast fragments washed free of small molecules have been investigated in the Hill reaction with respect to the kinetics of their dependence on chloride-ion concentration, oxidant concentration, temperature, and oxygen pressure. The large effect of chloride ion cannot be attributed to ionic strength variation, even though some other ions produce similar effects. Temperature studies demonstrate an even greater thermal instability than previously expected. The photoreduction process is opposed by an oxidation process also catalyzed by chloroplast fragments. The latter reaction is dependent on oxygen partial pressure and the redox potential of the ferricyanide-ferrocyanide half cell. Operations at high reduction potential produce anomalously low reaction velocities and yields. The occurrence of the back reaction may very well set an upper limit to the reduction potential in plants. (auth)

541
CRYOSCOPY IN MOLTEN LITHIUM BORATE. Eugène Darmois and Georges Zarzycki. Compt. rend. 233, 1110-12(1951) Nov. 5. (In French)

Cryoscopic curves are shown for LiCl, NaCl, $BaCl_2$, NiO, and TiO_2 in fused Li metaborate, $LiBO_2$ (m.p. 840°C). $LiBO_2$ dissociates into Li^+ and BO_2^-, the chlorides are completely dissociated, and the oxides do not dissociate. The molal depression constant K_f for $LiBO_2$ is 15. From this value the heat of fusion is calculated by Van't Hoff's equation to be $L_f = 8.3 \pm 0.6$ kcal/mole.

542
A CONTRIBUTION TO THE STUDY OF IONS OF QUADRI- AND PENTAVALENT VANADIUM. L.-P. Ducret. Ann. chim. (12) 6, 705-73(1951) Sept.-Oct. (In French)

Extensive experimental studies are reported on the nature of aqueous vanadates, the existence of V(V) cations in acidic solutions, precipitation and properties of V(IV) hydroxide, nature of the complexes of V(IV) with oxalate, tartrate, citrate, fluoride, and other ions, and the oxidation-reduction potentials of the V(V)/V(IV) couple.

ANALYTICAL PROCEDURES

543
Illinois Univ.
FLUOROMETRIC DETERMINATION OF TRACES OF BERYLLIUM; by H. A. Laitinen and Pekka Kivalo. [nd] 28p. (AECU-1734)

A study has been made of the variables which affect the fluorescence of Be in alkaline solution in the presence of purified morin, and a simplified procedure for the fluorometric determination of Be is given. A method of purification of morin is described. The effects of salt concentration, morin concentration, sodium hydroxide concentration and temperature are given. Phosphate is removed by precipitation as bismuth phosphate from nitric acid solution. Ca, if present in large amounts, is partly removed as the sulfate. The Be may be gathered by precipitation with hydrous ferric oxide at pH 6 to 6.3, followed by electrolytic removal of the iron at a mercury cathode. Alternatively, following the removal of phosphate, the solution may be electrolyzed and subjected to the acetylacetone extraction method of Toribara and Chen. By this combined method, even samples high in phosphate may be analyzed for Be without a gathering step. (auth)

544
Atomic Energy Research Establishment, Harwell, Berks (England)
THE DETERMINATION OF MOLYBDENUM IN URANIUM MOLYBDENUM ALLOYS; by M. Gibson. May 1950. 6p. (AERE-C/M-64)

545
Atomic Energy Research Establishment, Harwell, Berks (England)
THE DETERMINATION OF URANIUM IN URANIUM MERCURY ALLOY; by M. Gibson. May 1950. 2p. (AERE-C/M/65)

546
Western Reserve Univ. School of Medicine
PREPARATION AND PROPERTIES OF A CELL-FREE FORMIC HYDROGENLYASE SYSTEM FROM ESCHERICHIA COLI; by Howard Gest and Martin Gibbs; Western Reserve Univ. School of Medicine and Brookhaven National Lab. 8p. [nd] (BNL-1010)

The preparation and several properties of a cell-free "formic hydrogenlyase" from Escherichia coli are described. The enzyme system is markedly inhibited by the metal-complexing agent, α,α^1-dipyridyl, and the inhibition is most effectively relieved by Fe^{++}. In contrast to the "hydrogenlyase" activity, the hydrogenase activity of the cell-free extract with fumarate as the acceptor is relatively insensitive to α,α^1-dipyridyl. (auth)

547
Commissariat à l'Énergie Atomique
ANALYSIS OF HYDROGEN-DEUTERIUM MIXTURES AND OF MIXTURES OF HEAVY-WATER AND LIGHT-WATER BY MEANS OF A MASS SPECTROMETER (ANALYSE DES MÉLANGES HYDROGÈNE-DEUTERIUM-ET DES MÉLANGES D'EAU LOURDE ET D'EAU LÉGÈRE-AU MOYEN DU SPECTROMÈTRE DE MASSE); by J. Chenouard, J. Gueron, and E. Roth. July, 1951. 35p. (CEA-87)

The method in use at this laboratory to determine the D content of heavy water is described. After discussing the principles and precision of mass spectrometry of H_2-D_2 mixtures, the authors consider the problem of deducing the isotopic composition of water in equilibrium with these mixtures. The equilibration method is described in detail. The accuracy of mass spectrometry is compared with other methods used to analyze heavy water.

548
Research Lab. of Electronics, Mass. Inst. of Tech.
THE MICROWAVE SPECTRUM OF KETENE (Technical Report No. 192); by H. R. Johnson and M. W. P. Strandberg. Mar. 14, 1951. 21p. (NP-3503)

The microwave absorption spectra of the Ketene molecules $H_2^1C_2^{12}O^{16}$, $H^1D^2C_2^{12}O^{16}$, and $D_2^2C_2^{12}O^{16}$ have been investigated. Reciprocal moments of inertia have been determined for each from the measurements. The centrifugal distortion theory of Hillger and Strandberg has been found valid for both Q and R branches. The structure has been calculated and dipole moment measured; results check and extend the accuracy of values previously determined by other methods. Intensities of satellites of the lightest molecule corresponding to the lowest three vibrational fundamentals have also been measured, and changes in the average reciprocal moments determined. The vibrational frequencies have been calculated and found different from values reported in the literature by infrared workers. References and suggestions for further work are given. (auth)

549

DETERMINATION OF TRACES OF SODIUM, COPPER, AND RARE EARTHS IN ALUMINUM OF HIGH PURITY BY PILE ACTIVATION. Philippe Albert, Michel Caron, and Georges Chaudron. Compt. rend. 233, 1108-10(1951) Nov. 5. (In French)

Double-electrolysis Al (99.998%) was shown by pile activation to contain ~4 ppm of Na, ~2 ppm of Cu, and of the order of 1/10 or 1/100 of these concentrations of rare earths. Some of the rare earths, particularly Sm and Ho, follow the Cu in the separation process following activation, being adsorbed on the CuS precipitate.

CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE

550

NOTE ON THE HYDROGEN-DEUTERIUM ISOTOPE EFFECT IN CRYSTALS. Christer E. Nordman and William N. Lipscomb. J. Chem. Phys. 19, 1422(1951) Nov.

Brief note is made of the isotope effect on long hydrogen bonds. In the 3-body system O—H—O the H is moving in an approximately 1-dimensional potential field along the x axis, with the end atoms at ±d. The probability distribution function is shown to have two distinct peaks corresponding to the two minima in the field potential U. One peak will nearly coincide with the minimum of $V(d + x)$, the other will be approximately in the region of the minimum of $V(d - x)$, where, however, the derivative of $V(d + x)$ almost vanishes. It is shown that the change in d produced by isotopic substitution is small.

DEUTERIUM AND DEUTERIUM COMPOUNDS

551

Brookhaven National Lab.

STUDIES ON THE CATALYTIC REDUCTION OF ACETONE; by Lewis Friedman and John Turkevich. [nd] 15p. (BNL-1023)

Catalytic reductions of acetone to propane and isopropanol have been investigated using deuterium. A mechanism involving direct addition of deuterium is favored in both reactions. The synthesis of $(CH_3)_2CD_2$ by this method is not possible because of exchange of deuterium with an intermediate in the reduction process. Conditions have been found for the synthesis of $(CH_3)_2CDOD$. (auth)

FLUORINE AND FLUORINE COMPOUNDS

552

Illinois Inst. of Tech.

THE ACIDS OF THE HYDROGEN FLUORIDE SYSTEM; I. PROGRESS REPORT FOR THE PERIOD SEPTEMBER 1, 1950, TO MAY 15, 1951; by Alan F. Clifford. II. RENEWAL PROPOSAL FOR THE PERIOD SEPTEMBER 1, 1951, TO AUGUST 31, 1952; by Mervin E. Runner. [nd] 10p. (AECU-1711)

Investigations of redox reactions in the HF solvent system by means of the polarograph and other electrometric techniques have been started. A compact and convenient apparatus of Kel-F for taking polarograms with a dropping-Hg cathode is briefly described. A high wave, attributed tentatively to hydrogen ion, was observed, having a half-wave potential of about 1.2 v vs. the mercury-pool anode. Among several systems investigated, reproducible reduction waves were obtained on the following: tetrabutyltin, 0.76 v (5 runs, standard deviation ± 0.03 v) with one run in sodium fluoroborate solution at 0.72 v; aquocupric ion, 0.22 and 0.27 v (2 runs); and fluorosulfonic acid, 0.43 v (18 runs, standard deviation ± 0.02 v).

553

REACTIONS OF FLUOROCARBON RADICALS. PART V. ALTERNATIVE SYNTHESES FOR TRIFLUOROMETHYLACETYLENE (3:3:3-TRIFLUOROPROPYNE), AND THE INFLUENCE OF POLYFLUORO-GROUPS ON ADJACENT HYDROGEN AND HALOGEN ATOMS. R. N. Haszeldine. J. Chem. Soc., 2495-2504(1951) Sept.

Syntheses of trifluoromethylacetylene from trifluoroacetic acid or trifluoroiodomethane by preparation and dehydrohalogenation or dehalogenation of compounds of the type $CF_3.CH_2.CHXY$, $CF_3.CH{:}CHX$, $CF_3.CX_2.CHY_2$, $CF_3.CX{:}CH_2$, and $CF_3.CX{:}CHY$ (X or Y = halogen other than fluorine) have been investigated. 3,3,3-Trifluoropropene has proved to be the most convenient intermediate for the preparation of comparatively large amounts of the acetylene. The influence of the trifluoromethyl group on the reactivity of hydrogen and halogen atoms attached directly to it, attached to an adjacent carbon atom, and attached to the carbon atom once removed is considered. The infrared spectrum of trifluoromethylacetylene is reported. (auth)

554

THE STRUCTURE OF TRIFLUOROMETHYL ACETYLENE FROM THE MICROWAVE SPECTRUM AND ELECTRON DIFFRACTION PATTERN. J. N. Shoolery, R. G. Shulman, William F. Sheehan, Jr., Verner Schomaker, and Don M. Yost. J. Chem. Phys. 19, 1364-9(1951) Nov.

Measurements, in the microwave region, of the $J = 3 \rightarrow 4$ rotational transitions of trifluoromethyl acetylene and several of its isotopic modifications have been made, and the moments of inertia, I_B (in amu-A^2), have been found for the ground vibrational state: for CF_3CCH, 175.61_3, $CF_3C^{13}CH$, 177.02_4, $CF_3CC^{13}H$, 181.30_2, and CF_3CCD, 187.46_2. Three lines corresponding to $J = 3 \rightarrow 4$ transitions of CF_3CCH in the excited vibrational state $v_{10} = 1$, and two lines corresponding to $v_{10} = 2$ and $v_{10} = 3$, have also been measured and interpreted according to Nielson's theory of l-type doubling in symmetric tops. From Stark-effect measurements at different electric field strengths the dipole moment of CF_3CCH in the ground vibrational state has been found to be 2.36 ± 0.04 Debye units. For the ground vibrational state the microwave data lead to the following bond distances: C—H, 1.056 ± 0.005A; C≡C, 1.201 ± 0.002A. The C—C and C—F distances were calculated from the measured moments of inertia for several assumed values of the FCF angle. Electron-diffraction experiments were also made, and the intensity curves calculated for the assumed microwave models were compared with the observed visual curve. From the combination of microwave and electron-diffraction results the best agreement was obtained with the following set of parameters: ∠FCF, 107.5 ± 1°; C—C, 1.464 ± 0.02A; C—F, 1.335 ± 0.01A. (auth)

555

ON THE ELECTRON AFFINITY OF FLUORINE. Reed H. Johnston. J. Chem. Phys. 19, 1391-3(1951) Nov.

The hamiltonian for systems isoelectronic with neon is treated by perturbation methods. The energy of ionization of such systems is represented by a four-term expression (i.e., to third order of perturbation); the two leading terms are calculated; spectroscopic data for isoelectronic systems are used to evaluate the constants in the two remaining terms. The electron affinity of fluorine is estimated to be 73 ± 3 kcal/g atom. The corresponding dissociation energy of fluorine, as inferred by the Born-Haber cycle, is estimated to be 18 kcal/mole, to an accuracy believed better than ±12 kcal/mole. (auth)

RADIATION EFFECTS

556

Argonne National Lab.

EFFECT OF IONIZING RADIATIONS ON LIQUIDS; by Sheffield Gordon, E. J. Hart, and P. D. Walsh. Nov. 1, 1951. 11p. (AECU-1742; ANL-4613(p.52-63); UAC-461)

Two means have been developed for studying the effect of the type of radiation on dissociation and recombination reactions in aqueous solutions. One method, based on an analysis of the products of the formic acid–oxygen reaction, was described in Quarterly Report ANL-4564, sect. 2.1.1. This method has been extended to a comparison of the effects of Co^{60} γ rays and tritium β rays on H_2O. A second method is based on the ratio of ferrous sulfate oxidation in the presence and absence of air. This method has been applied to a study of the effects of Co^{60} γ rays, mixed CP-3′ pile radiation, and the products of the $B^{10}(n,\alpha)$ reaction. Several additional scouting experiments have been carried out in connection with the Co^{60} γ-ray-induced exchange between D_2 gas and liquid H_2O. (See ANL-4564, sect. 2.2.3 and ANL-4526, sect. 2.2.1 for previous results.) The effects of D_2 concentration, radiation intensity, type of chain reaction, and addition of ferrous sulfate are discussed. Stable O^{18} tracer is being used to characterize the mode of H_2O_2 formation in the γ-ray-induced $H_2O + O_2$ reaction. These studies are continuing.

557

LOCALIZED ELECTRONIC STATES IN BOMBARDED SEMICONDUCTORS. Hubert M. James and Karl Lark-Horovitz. Z. physik. Chem. 198, No. 1/4, 107-26(1951) Oct.

Bombardment of germanium and silicon with fast α-particles, deuterons, neutrons or electrons produces striking changes in the electrical and optical properties of these materials.

It is the purpose of this paper to develop a more complete basis for the understanding of these and other properties of bombarded semiconductors. A discussion of the effects of substitutional impurities is followed by an analysis of the action of vacancies in polar crystals as acceptors and donators. It is then argued that lattice vacancies in germanium and silicon will act as acceptors, and interstitial atoms will act as donators, for more than one electron; in other words, interstitials will show several successively increasing electron ionization energies, and vacancies several successively increasing hole ionization energies. Analysis of observations on bombarded germanium indicates that the second electron ionization energy of germanium interstitials is of the order of the forbidden band width, 0.75 ev, and that the second hole ionization energy is low, of the order of 0.2 ev; it then appears that in bombarded germanium the ζ-level is determined by the equilibrium between singly and doubly ionized interstitials and vacancies. In the case of silicon, it appears that the second hole ionization energy is much larger ($\sim$0.75 ev) and that the second electron ionization energy is increased to about 1 ev; in bombarded silicon most of the interstitials and vacancies will be singly ionized. (auth)

RARE EARTHS AND RARE-EARTH COMPOUNDS

558

Ames Lab.

ACTIVITY COEFFICIENTS OF RARE EARTH CHLORIDES IN AQUEOUS SOLUTIONS AT 25°C; by F. H. Spedding, P. E. Porter, and J. M. Wright. Dec. 7, 1951. 13p. (ISC-187)

The activity coefficients of the chlorides of La, Ce, Pr, Nd, Sm, Eu, Er, and Yb in aqueous solutions have been measured by means of concentration cells with transference. The data agree well with the Debye-Hückel theory, although a small deviation begins about 0.1N. The magnitudes of the Debye-Hückel $\overset{\circ}{a}$ values exceed the sums of the crystallographic ionic radii of rare earth ions and chloride ion by about the diameter of one water molecule; thus, they are reasonable values for the distances of closest approach. (auth)

559

Ames Lab.

METHODS OF PREPARING SPECTROGRAPHICALLY PURE PRASEODYMIUM SALTS; by F. H. Spedding and T. A. Butler. June 1951. 58p. (ISC-148)

An ion-exchange process was developed for the separation of spectrographically pure praseodymium salts in kilogram amounts from commercially available concentrates. The application of either 0.5% or 0.1% citrate solutions as eluting agents was shown to result in excellent separations of praseodymium from samarium, neodymium, and lanthanum when the mixed rare earths were eluted from Amberlite IR-100 or Nalcite HCR cation-exchange resins. (auth)

560

Ames Lab.

SOME CALORIMETRIC STUDIES OF THE METALS AND CHLORIDES OF CERIUM AND NEODYMIUM; by F. H. Spedding and Carl F. Miller. July 25, 1951. 131p. (ISC-167)

The following thermal data have been measured for some of the compounds and metals of Ce and Nd: heats of solution and dilution and changes in heat capacities of solution and dilution of the anhydrous chlorides in aqueous solution; heats of solution of the anhydrous chlorides and metals in aqueous HCl; heats of solution of the hydrated chlorides in aqueous solution; heats of precipitation of the oxalates in aqueous oxalic acid solution; and heat capacity of Nd metal in the temperature range 0 to 250°C. In addition, the heats of solution and dilution of KCl and oxalic acid hydrate in aqueous solution and the heat capacity of Ta metal from 0 to 425°C have been measured. From the data on the heats of solution and dilution, the following thermodynamic quantities have been determined for Ce and Nd: relative apparent molal and relative partial molal heat contents and heat capacities of solutions of the chlorides; heats of formation of the anhydrous chlorides; heats of hydration and formation of the hydrated chlorides; heats of formation of the hydrated oxalates; and heats of formation of the ions. Revised values for the heat of solution at infinite dilution of KCl and the heat of formation of oxalic acid hydrate are presented. With the aid of data in the literature, the entropies, entropies of formation, and free energies of formation of the above chemical substances as well as the standard electrode potentials of Ce and Nd metals have been calculated.

561

Ames Lab.

QUANTITATIVE CALCULATION OF THE BEHAVIOR OF ELUTION BANDS IN THE SEPARATION OF RARE EARTHS ON ION-EXCHANGE COLUMNS; by F. H. Spedding and J. E. Powell. Nov. 24, 1951. 3p. (AECU-1740)

A brief outline is presented of the quantitative theory for the separation of rare earths on the ion-exchange column in the pH range between 5.5 and 7.3 for 10% citric acid. Some interesting quantitative relationships concerning the movement of bands on the column are discussed.

562

Ames Lab

CONDUCTANCES, TRANSFERENCE NUMBERS, AND ACTIVITY COEFFICIENTS OF SOME LOW ATOMIC NUMBER

RARE EARTHS IN AQUEOUS SOLUTION; by F. H. Spedding and Paul Edward Porter. Mar. 1951. (ISC-142)

The conductances, transference numbers, and activity coefficients of aqueous solutions of the chlorides of La, Ce, Pr, and Nd have been determined for concentrations up to 0.1N. The transference numbers were determined by the moving-boundary method; the activity coefficients were measured by using concentration cells with transference; and the conductances were obtained with a conventional apparatus of the type recommended by Jones and Josephs (J. Am. Chem. Soc. 50, 1049-92(1928)). The conductance data for all four rare earths agree with the Onsager limiting law up to about 0.002N. There is a regular decrease in the conductances of solutions of the rare-earth chlorides with increasing atomic number beginning at about Nd. The chlorides of La, Ce, and Pr have about the same conductances, while that of neodymium chloride is slightly higher. The transference numbers do not merge with the theoretical Onsager limiting slope. Little change in transference numbers is observed for the first four rare earths; beginning with Nd a regular decrease with increasing atomic number is observed. The activity coefficients agree well with the Debye-Hückel theory. The average effective ionic diameter shows no regular decrease but does show an increase up to Nd; for all four rare earths it exceeds the sum of the ionic radii of the rare-earth ions with the chloride ion by approximately the diameter of one water molecule. Possible interpretations are suggested for the observed effects.

563
Ames Lab.
TRANSFERENCE NUMBERS OF RARE EARTH CHLORIDES IN AQUEOUS SOLUTION AT 25°C; by F. H. Spedding, P. E. Porter, and J. M. Wright. Dec. 7, 1951. 10p. (ISC-169)

The cation transference numbers of the chlorides of La, Ce, Pr, Nd, Sm, Eu, Er, and Yb in aqueous solutions have been determined in the concentration range from 0.007N to 0.1N. The numbers for the first five earths are about the same, while a regular decrease with increasing atomic number seems to occur for elements beyond Sm. The data for Sm chloride are slightly higher than anticipated from the conductance data (Spedding, Porter, and Wright (paper in press)), while the other earths lie in the expected order. The plots of data for all but Yb were linear functions of the square root of concentration in the range studies; however, the slopes of the lines were not in agreement with the Onsager limiting values. This behavior is in agreement with the previous observation of Longsworth and MacInnes (J. Am. Chem. Soc. 60, 3070-3074 (1938)) for lanthanum chloride. The plot for Yb curved downward at high dilution, but this effect may have been due to the greater difficulty in measurements for this salt. (auth)

564
ION ASSOCIATION IN AQUEOUS SOLUTIONS OF METAL DICARBOXYLATES. J. M. Peacock and J. C. James. J. Chem. Soc., 2233-9(1951) Sept.

The effects of structural factors and the nature of the linkages between cations and dicarboxylate ions in aqueous solution have been studied by potentiometric, conductometric, and spectrophotometric methods for the ion associations LaX$^+$, Co(NH$_3$)$_6$X$^+$, MgX, CaX, BaX, ZnX, and CuX, where X represents oxalate, malonate, succinate, glutarate, adipate, phthalate, maleate, and fumarate. Dissociation constants are given.

SYNTHESES

565
Presbyterian Hospital, Chicago
THE TURNOVER RATE OF FIBRINOGEN IN THE DOG[1,2] (thesis); by Robert E. Madden and R. Gordon Gould. [nd] 20p. (AECU-1731)

A rapid method of isolation of fibrin in pure form and preparation for S^{35}-assay has been developed. The turnover rate of fibrinogen in the normal intact animal has been determined both by following the increase in S^{35} concentration during a period of labeled substrate feeding and the decrease following a large dose. Both S^{35}-dl-methionine and S^{35}-labeled yeast were used as substrates, and the importance of feeding high levels of inert S-amino acids while following the decrease in S^{35} concentration was emphasized. The average time for 50% regeneration was 4.2 days, corresponding to a regeneration time of 6.0 days, which is faster than that of any other plasma protein. The difference between this value and the various previous values determined under unphysiologic conditions has been discussed. Preliminary results on two humans gave an average turnover time of 4.9 days. (auth)

566
Sloan-Kettering Inst. for Cancer Research
STUDIES ON THE METABOLISM OF THE NUCLEIC ACIDS; by Aaron Bendich. [nd] 36p. (AECU-1735)

The characteristics of nucleic acids are reviewed. Results of studies of the incorporation and retention of C^{14} formate in nucleic acids of normal and regenerating tissues of rats are presented in tabular form and discussed in detail. 68 references.

567
Utah Univ.
THE BACK-REACTION IN THE PHOTOLYSIS OF WATER BY ILLUMINATED CHLOROPLAST FRAGMENTS (abstract); by John D. Spikes. [1951]. 1p. (AECU-1736)

The report comprises an abstract of a paper presented at the meeting of the American Society of Plant Physiologists, Minneapolis, Sept. 9-12, 1951, and is reproduced here in its entirety.

If chloroplast fragments are illuminated in the presence of a suitable oxidant a reaction occurs in which water is oxidized to oxygen gas and hydrogen ion while the oxidant is reduced. This reaction does not go to completion since there is a competing back-reaction which is independent of light. This back-reaction is apparently catalyzed by some constituent of the chloroplast fragments. The kinetics of this reaction have been studied as a function of temperature, light intensity, inhibitors, etc. The results are of interest with respect to the question of energy-transfer methods in photosynthesis.

568
Argonne National Lab.
SYNTHESIS, p.171-6 of QUARTERLY REPORT, FEBRUARY, MARCH, APRIL, 1951; DIVISION OF BIOLOGICAL AND MEDICAL RESEARCH; Austin M. Brues, ed. [nd] 6p. (ANL-4625(p.171-6))

Synthesis of the plant-growth hormone indoleacetic acid C^{14}-methylene-labeled has been accomplished through (1) reduction of BaC^{14}O$_3$ with LiAlH$_4$ to methanol, (2) catalytic oxidation of the methanol to formaldehyde, (3) formation of gramine by reaction of formaldehyde, indole, and dimethylamine, and (4) conversion of gramine to indoleacetic acid via the nitrile. The over-all yield was 70%; m.p., 164 to 166°C. A total of 23 g of C^{14}-labeled dextran with an absolute activity of 116.8 μc/g has been biosynthesized by fermentation of C^{14}-sucrose, the preparation of which by photosynthesis from C^{14}O$_2$ is described.

569
SYNTHESIS OF GUANINE-8-C^{14}. Friedrich Weygand and Otto Alfred Grosskinsky. Chem. Ber. 84, No. 9, 839-43(1951) Oct. 29. (In German)

C^{14}-labeled K formate, from a $BaC^{14}O_3$ source, was used in the ring closure of 6-hydroxy-2,4,5-triaminopyrimidine to yield guanine-8-C^{14} in 70 to 75% yield (based on $BaC^{14}O_3$). The yield in activity was only slightly smaller, in contrast to similar reactions in which there has been reported 50 to 75% exchange between C^{14} and C^{12}.

570

CALABASH CURARE ALKALOIDS. VI. LABELED C-CURARINE I CHLORIDE. H. Schmid, K. Schmid, P. Waser, and A. Ebnöther. Helv. Chim. Acta 34, No. 6, 2042-4(1951) Oct. 15. (In German)

C-Curarube I chloride labeled in the methyl group attached to the basic N(b) atom has been synthesized by the reaction of the N-methyl-free norcurarine I base with $C^{14}H_3I$. A quantity of 38.04 mg (93% yield) was obtained with specific activity of 2.81 μc/mg.

571

SYNTHESIS OF 1:3-DIHYDROXY[2-^{14}C]ACETONE. H. R. V. Arnstein and Ronald Bentley. J. Chem. Soc., 2385-90(1951) Sept.

The synthesis of dihydroxyacetone described by Piloty (Ber., 30, 3161(1897)) has been improved and applied to the synthesis of dihydroxyacetone labeled with radioactive carbon. A new synthesis of dihydroxyacetone by acid decomposition of the sodium salt of 2-nitropropane-1,3-diol has been demonstrated in tracer experiments. This provides a rapid synthesis of labeled dihydroxyacetone when some dilution of radioactivity can be tolerated. (auth)

TRACER APPLICATIONS

572

Brookhaven National Lab.

EXCHANGE BETWEEN THE TRIS-(5,6-DIMETHYL-1,10-PHENANTHROLINE) COMPLEXES OF IRON (II) AND (III); by Lois Eimer and A. I. Medalia. [nd] 6p. (AECU-1751)

Ferroin-5,6 (the red ferrous complex with 5,6-dimethyl-1,10-phenanthroline) and ferriin-5,6 (the blue ferric complex) were prepared for a study of exchange reactions proceeding via transfer of an electron. Fe^{55} was used as a tracer. Two methods of separation of the complexes are described. Results indicate that a complete exchange is found between ferroin-5,6 and ferriin-5,6 at 0°C at concentrations of 2.2×10^{-5} formal and 4.2×10^{-4} formal in both species.

URANIUM AND URANIUM COMPOUNDS

573

Ames Lab.

STUDY OF THE KINETICS OF THE REACTION BETWEEN URANIUM, H_2, HD, and D_2; by Harry J. Svec and Frederick R. Duke. Mar. 1, 1950. 36p. (ISC-105)

The kinetics of the reactions between uranium metal, H_2, HD, and D_2 have been examined. There is strong evidence that the reaction involves several steps of which activated adsorption of the gas by the metal is the rate-governing process. Rate constants have been determined for the over-all processes in the temperature range 27.5 to 75°C. Energies of activation which are of reasonable magnitude have been calculated being 10,200 cal for the process involving D_2, 8500 cal for the process involving HD and 8200 cal for the process involving H_2. From a consideration of the zero-point energies for these three molecular species of hydrogen, these results follow in the right order. However, because of the adsorption step and since it is not possible to determine the heat of adsorption it is impossible to state that the observed activation energies are the true activation energies. Since the heat of adsorption during the process must be considered in the final interpretation of the results, the true activation energies are probably less positive than those observed. The adsorption step in the processes also accounts for the fact that the ratios of the rates of the reactions, which may be expected to differ inversely as the square roots of the reduced masses of the gas molecules, deviate somewhat from the theoretical values. (auth)

574

COULOMETRIC TITRATION OF MICROGRAM QUANTITIES OF VANADIUM IN URANIUM. N. Howell Furman, Charles N. Reilley, and W. Donald Cooke. Anal. Chem. 23, 1665-7(1951) Nov.

This investigation was undertaken to test the application of the coulometric titration process to the estimation of milligram and microgram amounts of V in the presence of macro quantities of U. With judicious choice of reagents for the prior reduction or oxidation of the substance that is to be determined, a high degree of accuracy may be attained. In the microgram range a sufficiently sensitive method of determining the end point must be adopted. By opposing a suitable potential to a cell composed of an indicator electrode and a reference electrode and titrating to zero current with a galvanometer of high sensitivity, indication is achieved that is capable of almost unlimited sensitivity. This procedure may be considered from the viewpoint of an amperometric or potentiometric titration. The galvanometer sensitivity is so chosen that no significant amount of material is used by the indicating process itself. (auth)

ENGINEERING

575

Illinois Univ.

A SIMPLE, EFFECTIVE HIGH PRESSURE VALVE; by E. W. Comings and H. G. Drickamer. [nd] 3p. (AECU-1746)

A simply constructed high-pressure valve which has been tested to 30,000 psia with oil and to 20,000 psia with gas without leak is sketched.

576

AN ELECTRONIC METHOD OF DETECTING IMPURITIES IN THE AIR. G. Phillips. J. Sci. Instruments 28, 342-7(1951) Nov.

Impurity concentrations in clean dry air of one part in 10^7 by weight of polar vapors or of one part in 10^4 by weight of nonpolar vapors were measured in terms of changes in surface potential of a prepared plate. Changes of potential of the order of 10 μ v were measured using a vibrating condenser technique and a selective phase-sensitive amplifier. The results suggest that, while the adsorption is caused mainly by electrostatic attraction between the dipole and its induced image, a small contribution is also caused by van der Waals attractive forces. The possibilities of obtaining selective adsorption and some of the practical applications are discussed briefly. (auth)

HEAT TRANSFER

577

[Oak Ridge National Lab.]

PRELIMINARY STEAM POWER CYCLE STUDIES FOR FULL SCALE HOMOGENOUS REACTORS; by W. K. Stair. Mar. 12, 1951. 23p. (CF-51-3-120)

Calculated data relating exhaust quality, throttle pressure, superheat, thermal efficiency, etc., are presented for two types of homogeneous UO_2SO_4-D_2O reactors: the high-pressure circulating-fluid type and the boiling type. The 27 individual cycles summarized include five types of steam-power cycles. Cost figures on the cycle components are not presented, but some estimate of the relative investment required may be gained from a comparison of the turbine steam-main size, the condenser surface area, and the heat-exchange surface area required. The economics of the heat-exchanger problem has not been investigated to the point of evaluating the balance between tube diameter, fluid velocity, and friction loss.

578

NEPA Div.

REPORT ON THE THERMAL CONDUCTIVITY OF SOME REFRACTORY MATERIALS AT ELEVATED TEMPERATURES; by M. A. Schwartz. Apr. 1949. 17p. (NEPA-1015)

579

Columbia Univ.

BOILING AND CONDENSING OF LIQUID METALS; by C. F. Bonilla, J. S. Busch, H. T. Chu, B. Misra, and S. J. Wang. Oct. 24, 1951. 8p. (NYO-3147)

An apparatus has been constructed for study of the boiling of mercury from a horizontal plate up to 300,000 Btu/ft^2/hr. Another apparatus is partially constructed for study of the condensation of mercury vapor on a vertical tube at high heat fluxes. A third apparatus is partially constructed for the comparison of electrical and thermal contact resistances. Preliminary values for thermoelectric potential of the thermocouple mercury-iron have been obtained.

580

THE TEMPERATURE VARIATION OF THE COMPRESSIBILITY OF MOLTEN SODIUM. T. E. Pochapsky. Phys. Rev. 84, 553-8(1951) Nov. 1.

The present method for the determination of the adiabatic compressibility of molten sodium depends in the first instance upon the measurement of the velocity of propagation of a short train of ultrahigh frequency compressional acoustic waves in the material. This figure is then combined with the best available value of the density to yield the compressibility, on the assumption that the rigidity of the liquid is zero. The wave trains are produced and detected by a piezoelectric transducer, and the resultant signal is exhibited on the screen of an oscilloscope whose sweep circuit is time-calibrated to permit the measurement of the transit time of a train over a known path length in the medium. A novel acoustic interferometer is employed, with which small changes in velocity can be measured with high precision. The velocity of compressional waves in molten sodium at the freezing point, 97.6°C, is 252,600 ± 500 cm/sec, and its temperature coefficient remains constant at the value -52.4 ± 0.3 cm/sec°C at least to 545°C. The adiabatic compressibility is 16.85×10^{-12}cgs at 97.6°C, and its temperature coefficient increases from 0.012×10^{-12} cgs at this temperature to 0.013×10^{-12} cgs at 545°C. The relations between these quantities and other elastic and thermal properties of solid and liquid sodium are discussed. (auth)

581

SCALE-MODEL STUDIES OF EFFECTS OF FORCED VENTILATION ON EFFECTIVENESS OF HEATERS IN AN ENCLOSURE. L. I. Ginzburg. Izvest. Akad. Nauk S.S.S.R. Otdel. Tekh. Nauk, No. 4, 537-49(1951) Apr. (In Russian)

VACUUM SYSTEMS

582

REVIEW OF VACUUM GAUGES. W. Steckelmacher. J. Sci. Instruments, Suppl. 1, 10-19(1951).

A short account is given of methods for measuring pressures below 10 mm Hg and of the limitations of conventional gages for accurate measurement. The applications of gages to industrial processes and their use as protective devices are discussed. (auth)

583

GENERAL PRINCIPLES OF LEAK DETECTION. J. Blears. J. Sci. Instruments, Suppl. 1, 20-8(1951).

The techniques of leak detection are reviewed, special emphasis being placed on methods for obtaining high sensitivity with simple apparatus. A theoretical analysis of the gas flow problem is supplemented by experimental results obtained with a system using two diffusion pumps in cascade. The importance of using constrictions and correctly positioning the gage is stressed, and the losses of sensitivity due to virtual leaks, leaks in series and by-pass methods are considered. The relative sensitivities of different leak detection methods are tabulated. (auth)

584

A COLD-CATHODE MASS SPECTROMETER LEAK DETECTOR. C. J. Milner. J. Sci. Instruments, Suppl. 1, 29-36(1951).

A cold-cathode spectrometer has the advantages of robustness, long life, and avoidance of refrigerated traps. In the instrument described, the use of an a-c amplifier for the ion current, in conjunction with velocity modulation of the ion beam, greatly reduces background effects. Leaks smaller than 10^{-5} μl/sec can be detected in vessels whose gas output is up to 1 μl/sec. Gas outputs up to 100 μl/sec can be handled by the instrument's pumps, with proportional increases in detection limit. Various features of the design and characteristics are discussed. Some observations are made with regard to the applications and field of use of the instrument. (auth)

585

APPLICATION OF THE MASS SPECTROMETER TO HIGH VACUUM PROBLEMS. J. Blears. J. Sci. Instruments, Suppl. 1, 36-42(1951).

The potentialities of the mass spectrometer in studies of high vacuum problems are illustrated by descriptions of analyses of residual gases during initial evacuation, during baking and at the ultimate pressure. Surface exchange and synthesis products are considered, and it is concluded that mass spectrometry can solve many problems where it is difficult to distinguish between extraneous effects and real changes of pressure, or gas composition. (auth)

586

THE VACUUM SYSTEM OF THE BIRMINGHAM PROTON SYNCHROTRON. L. Riddiford. J. Sci. Instruments, Suppl. 1, 47-58(1951).

The theoretical requirements of the vacuum system of the Birmingham 1.3×10^9 ev proton synchrotron are considered, and the design and development work performed to satisfy these requirements is described in some detail. To be certain that no difficulty in operating the accelerator will be encountered because of gas scattering of the proton beam by the remaining molecules, it is necessary to produce a vacuum of about 1×10^{-6} mm Hg air equivalent in the extended vacuum chamber. The vacuum chamber has to be in the form of a hollow ring about 30 ft in diameter, with a rectangular cross section 40 × 10 cm. Because of the high degree of vacuum required, and the fact that a heavy hydrocarbon molecule "gas-scatters" very much more than does an air molecule, the problem of the ultimate vacuums of oil diffusion pumps is of the greatest importance. An attempt is made to throw some light on this difficult subject. (auth)

587

VACUUM GAGE USING ALPHA RAYS. C. Gimenez and J. Labeyrie. J. phys. radium 12, 64A-65A(1951) Oct. (In French)

Pressures between 0.1 and 100 mm Hg may be measured by means of the ionization current produced by a Po source of α particles. The instrument is particularly useful for corrosive-gas applications, such as the manufacture of Br_2-filled Geiger counters. Determination of the percentage composition of a binary gas mixture is possible by plotting the current-pressure curves for various compositions. Such curves are shown for He-Xe and A-Ne mixtures.

MINERALOGY, METALLURGY, AND CERAMICS

CORROSION

588

Corrosion Lab., Mass. Inst. of Tech.

RESISTANCE OF TITANIUM TO SULFURIC AND HYDROCHLORIC ACIDS INHIBITED BY FERRIC AND CUPRIC IONS (Technical Report No. 6); by Joseph R. Cobb and Herbert H. Uhlig. June 1951. 9p. (NP-3495)

Ferric and cupric ions are effective inhibitors for the corrosion of Ti in boiling 10% sulfuric and boiling 10% hydrochloric acids. As little as 0.005 mole of Fe^{+3} or Cu^{++} per liter reduces the corrosion rate from intolerably high values to those typical of class A materials. The corrosion rates range from 0.001 to 0.012 in./yr for inhibitor concentrations from 0.03 to 0.005 mole/liter. Although the inhibitors are consumed as titanium corrodes, the consumption is moderate, particularly at the higher inhibitor concentrations for which corrosion rates are lower. The primary mechanism, as indicated by potential measurements, is proposed as occurring through adsorption of Fe^{+3} and Cu^{++} on the metal surface with accompanying satisfaction of surface valences and formation of a dipole layer with negative charge outward accounting for a noble potential. (auth)

GEOLOGY AND MINERALOGY

589

Geological Survey

AIRBORNE RADIOACTIVITY SURVEY OF THE RED DESERT REGION, SWEETWATER COUNTY, WYOMING; by R. A. Nelson, W. N. Sharp, and F. W. Stead. July 1951. 30p. (TEM-147)

An airborne radioactivity survey of an area containing lignite and shale deposits of known surface extent and U content in the Red Desert, Sweetwater County, Wyo., was flown at various levels above ground with readings at one-quarter mile intervals. Corrections of the measurements for variations of speed of plane, differences in recording and sensitivity of instruments, and resolutions of measurements taken at various height were made. Profiles of radiation intensity, an isoradioactivity contour map, and correlation curves between radiation intensity and distance from the source are given. The experimental results conform to the relation for a broad source $e^{-\mu h}$. Effectiveness and economy of airborne surveys under such conditions are discussed. Airborne surveys are considered quicker and cheaper than ground surveys but are limited, with instrumentation available to date, to 1000 ft above ground and to gentle topography, since automatic corrections of measured radiation intensity for variation in distance from source are not available.

590

AERIAL PROSPECTING FOR RADIOACTIVE MINERALS. D. H. Peirson and E. Franklin. Brit. J. Applied Phys. 2, 281-91(1951) Oct.

The γ-ray flux over a radioactive mineral deposit has been calculated and expressions derived for the variation with operational flying conditions. An airborne equipment comprising 49 G-M tubes was designed to investigate the over-all sensitivity and the practical problems arising from the use of such a method of prospecting. Thus a surface mineral deposit of concentration factor (% U_3O_8 by weight) × area (sq yd) of about 100 is just detectable above "background" fluctuations at an altitude of 500 ft overhead and speed of 120 mph. The effect of deposit and background activity upon the comparative performance of Geiger and scintillation counters is such that a practical improvement of three times may be expected from the scintillation counter. (auth)

METALS AND METALLURGY

591

Armour Research Foundation

PHASE DIAGRAMS OF ZIRCONIUM-BASE BINARY ALLOYS; SEPTEMBER 1—NOVEMBER 1, 1951 (Report No. 5); by D. J. McPherson. Nov. 27, 1951. 44p. (COO-81)

Phase investigations during this period on the binary systems of Zr with Sn, Mo, Cu, W, Cr, Si, Al, and Mg are reported, and the present state of knowledge of these systems is shown in phase diagrams. Work in progress and planned is summarized. 25 figures.

592

Knolls Atomic Power Lab.

THE PRECISION DETERMINATION OF CARBON IN METALS BY A HIGH FREQUENCY COMBUSTION-VOLUMETRIC METHOD; by L. P. Pepkowitz and P. Chebiniak. Sept. 12, 1951. 12p. (KAPL-637)

A precision method for the determination of carbon in metals is presented utilizing a high-frequency combustion-volumetric procedure. A mean deviation of ±0.005% was attained on a 1-g sample with a lower limit of precise measurement of 0.02% C. A mean error of ±0.004% was obtained with National Bureau of Standards standard steels. The method has been applied to a variety of metals such as Bessemer steels, stainless steels, Ti, V, and Zr. The time for an analysis, not including the weighing interval, is 2 to 3 min.

593
Los Alamos Scientific Lab.
ACCELERATED CORROSION TEST OF STAINLESS STEEL SAMPLES IN AN EFFORT TO ESTABLISH GALVANIC ATTACK; by James T. Waber and Santon Waber. June 1, 1951. 26p. (LA-1302)

Tests were conducted on a variety of samples consisting of type 316 ELC plates welded to 347 plate, or to themselves with 347 type welding rod. The tests were made in a simulated hood through which moist HF and HCl fumes were passed. A grid system of taking specimen thickness before and after exposure failed to reveal any compelling evidence of galvanic attack. In some instances intergranular attack of the heat-affected zone was noted. The use of type 347 in conjunction with 316 ELC is not recommended.

594
Massachusetts Inst. of Tech.
THE HABIT PHENOMENON IN THE MARTENSITIC TRANSFORMATION; by E. S. Machlin and Morris Cohen. Aug. 1, 1951. 60p. (NP-3494; Technical Report No. 5)

Using single crystals of a 70% Fe, 30% Ni alloy with fiducial lines on three polished orthogonal faces, it is possible to measure the strains caused by the martensitic transformation in individual plates. The habit orientations of the same plates are also determined, and found to be permutations of $[259]_A$. With the aid of matrix algebra, it is shown that all the measured transformation strains are crystallographically equivalent, but do not generate the final martensite lattice. The conclusion is reached that the final structure and the correct orientation relationships are derived by a combination of two strains, each of which can be described as a homogeneous strain involving the motion of an invariant plane, i.e., a plane of no rotation and no distortion. The two strains must operate in proper sequence to achieve the final structure and orientation relationships. The habit plane lies parallel to, and is determined by the invariant plane of the first strain, thereby tending to minimize the strain energy developed during the formation of the plate. The second strain, which is calculated from the measured first strain and the final positions of the atoms in the martensite, is homogeneous only over regions small compared to the volume of the martensitic plate. Metallographic evidence is available to substantiate the existence of the calculated second strain. These results confirm the Bowles double-strain analysis, with the Kurdjumow-Sachs orientations corresponding to the $[225]_A$ habits and the Greninger-Troiano orientations corresponding to $[259]_A$ habits. All the observed crystallographic relationships are found to be consistent with the reaction-path theory of martensite formation, in which the transformation strain is visualized to propagate as a wave. (auth)

595
Massachusetts Inst. of Tech.
STRESS-INDUCED TRANSFORMATION OF RETAINED AUSTENITE IN HARDENED STEEL (Technical Report No. 3); by B. L. Averbach, S. G. Lorris, and M. Cohen. Aug. 1, 1951. 26p. (NP-3497)

The transformation of retained austenite in tapered tensile bars of hardened and tempered AISI 2340 steel was studied as a function of distance from the fracture. The as-hardened material originally contained 6% retained austenite. After the test, complete transformation of the retained austenite was found at the fracture and some transformation was detected in all sections where plastic strain had occurred. The retained austenite was completely converted before necking was observed. The stress-induced transformation proceeded more readily in the untempered steels, whereas after tempering at 400°F (205°C), considerably higher plastic strains were required for transformation. This effect is ascribed to the relaxation of strain embryos in the austenite during tempering. Determinations were also made of retained austenite as a function of distance from the fracture of V-notch slow-bend and Charpy impact bars. Complete transformation of the austenite was observed at the fracture, and some transformation was detected at appreciable distances from the fracture. (auth)

596
Naval Research Lab.
A MISCHMETAL ALUMINUM ALLOY FOR ELEVATED TEMPERATURE SERVICE; by B. M. Loring, W. H. Baer, and C. G. Ackerlind. Nov. 1, 1951. 24p. (NRL-3871)

The metallurgical and mechanical characteristics of a newly developed aluminum-mischmetal alloy (11% mischmetal, 1.5% Cu, 1.25% Ni, 1.0% Mn, 0.3% Cr, 0.02% Ti), termed SAM, have been investigated. The SAM alloy is shown to have stress-rupture properties superior to present commercial alloys in the range of 700 to 800°F (372 to 427°C). Room temperature strength is low, however. Room temperature ductility, while also low, is in the range of commercial cast aluminum alloys. Standard foundry practice for aluminum alloys may be applied to the casting of the SAM alloy. While the alloy is readily forgeable, the stress-rupture properties of the wrought form are decidedly inferior to those of the cast form. (auth)

597
[Carnegie Inst. of Tech.]
PROGRESS REPORT FOR JUNE 1951; by Alan Rothman, D. S. McKinney, and J. C. Warner. [nd] 9p. (NYO-548)

Various salts and complexing agents affected the anodic overvoltage of Ti and Zr in $2.06\underline{N}$ H_2SO_4 at a current density of 20μ amp/cm^2. The salts tested are from a list which caused Ti to corrode at a rate greater than 0.005 in./yr. Two general cases were observed in the plots of electromotive force vs. time: either there was a sudden drop in overvoltage, or there was only a slight overvoltage change due to a concentration effect. The slope of the plot was 0.14 ± 0.002 v/min, which was more reproducible for Zr than Ti. A graph for the solubility of ZnO as a function of pH at 70°C is also given.

598
Massachusetts Inst. of Tech.
SOLID SOLUTIONS AND GRAIN BOUNDARIES (Technical Progress Report No. 8, Scope II); by B. L. Averbach, M. Cohen, P. A. Flinn, L. L. Seigle, E. E. Underwood, W. E. Flanagan, P. S. Rudman, J. Hilliard. Sept. 30, 1951. 7p. (NYO-580)

Statements of investigations being carried out are given, but no results are reported. The complete thermodynamic functions for solid Ni-Au alloys are being computed, and some of these are being experimentally checked by the equilibrium Ni(in solid Ni-Au alloy) + H_2O(g) = NiO(g) + H_2(g). Thermodynamic activities in the Au-Fe, Al-Zn, and Al-Ag systems are being determined by the cell-emf method. X-ray-diffraction studies of the atomic arrangements in the Al-Zn face-centered cubic solid solutions and of the anomalous diffuse x-ray scattering of single-phase Ni-Au alloys are under way. The Hall coefficients of Ni-Au, Cu-Ni, and Cu-Au alloys are being measured.

599
Metals Research Lab., Carnegie Inst. of Tech.
ELECTROCHEMICAL STUDIES OF NON-AQUEOUS MELTS; QUARTERLY PROGRESS REPORT; PERIOD ENDING OCTOBER 1, 1951; by Robert F. Mehl and Gerhard Derge. Nov. 6, 1951. 9p. (NYO-827)

Measurements were made of the electrical conductivity of a molten 50 wt. % Cu_2S-FeS matte over a range of temperatures from about 1000 to 1200°C. These preliminary results indicate that the electrical conductivity is of the order of magnitude of 400/ohm/cm and is relatively independent of temperature. Experiments have been completed which give reasonable values if Fe^{++} and SiO_3^{--} are considered as the effective ions for the calculation of the transport number. The same assumptions show that Faraday's law is obeyed at low current densities. The decomposition potential of 5% CuCl in a molten LiCl-KCl eutectic was found to be in the region of 840 millivolts when Pt is used for both electrodes and the melt is under a N_2 atmosphere. V metal in a powdered form has been plated from a 5% solution by weight of VCl_2 in the molten LiCl-KCl eutectic while under an A atmosphere. The decomposition potential of 5% $NiCl_2$ in molten LiCl-KCl eutectic was found to be in the region of 695 millivolts using Pt as electrodes and under an A atmosphere. With a decrease in per cent of $NiCl_2$, the decomposition potential increased. This has been substantiated by the curves for CuCl and appears to be confirmed by curves for VCl_2. Decomposition potential curves for 5% CuCl, 5% $NiCl_2$, and 1 molal VCl_2 in a molten LiCl-KCl eutectic under an inert gas are presented.

600

Columbia Univ.

THE STUDY OF DIFFUSIONLESS PHASE CHANGES IN SOLID METALS AND ALLOYS; PROGRESS REPORT FOR JUNE 1 TO AUGUST 31, 1951; by T. A. Read, L. C. Chang, M. W. Burkart, D. S. Lieberman, S. Zirinsky, J. Intrater, R. Bakish, and J. W. Semmel. [nd] 6p. (NYO-933)

Mechanical, thermodynamic, x-ray-diffraction, and resistivity studies of Au−47.5 at.% Cd single crystals have continued (see NSA 5-3942, 5-3943, 5-3944, 5-5199). Studies on crystallography of transformation, effects of quenching on ordering, and imperfections are reported. In addition, the martensite transformations in Cu-Sn and Fe-Ni alloys have been investigated.

601

Metals Research Lab., Carnegie Inst. of Tech.

PROGRESS REPORT FOR JULY, AUGUST, SEPTEMBER, 1951; by R. Smoluchowski, L. Couling, S. Hayes, R. Flannagan, C. W. Haynes, B. Sawyer, R. W. Turner, and A. Pranatis. Oct. 15, 1951. 3p. (NYO-3177)

A study of diffusion of Zn along grain boundaries of columnar Cu showed that the depth of penetration for small angles between grains is not greater than that caused by volume diffusion, but starting at angles round 15 to 20° diffusion rapidly increases, reaching a maximum at 45°. From a study of recrystallization of Fe-Co alloys with and without a magnetic field it appears that the major effect of the magnetic field is due to its influence on grain growth rather than nucleation.

602

Metallurgical Labs., Sylvania Electric Products, Inc.

THE THEORIES OF THE SINTERING PROCESS; A GUIDE TO THE LITERATURE (1931-1951); by Herbert B. Michaelson. Issued Nov. 29, 1951. 41p. (SEP-80)

An annotated bibliography is compiled to serve as a guide to the literature of 1931 to 1951 on the theories of sintering and on the physical phenomena on which they are based. The notations are arranged according to subject matter, and an author index is provided. (auth)

603

Metallurgical Labs., Sylvania Electric Products, Inc.

SELF-DIFFUSION OF METALS AND ASSOCIATED PHENOMENA (VI); PROGRESS REPORT; APRIL 1, 1951 - NOVEMBER 30, 1951; by B. H. Alexander, R. W. Balluffi, M. H. Dawson, H. P. Kling, and F. D. Rosi. Issued Dec. 3, 1951. 17p. (SEP-81)

The study of the formation of pores by diffusion in binary systems was continued both on single crystals of α-brass and on polycrystalline specimens of Ag-Au. Experiments were also made on the diffusion of the high-mobility atom from the vapor phase in the systems Cu-Zn, Ni-Cu, and Au-Ag. The rate of diffusivities of Cu and Zn in polycrystalline α-brass at 890°C was found to be the same as the value obtained previously for single-crystal material. X-ray orientation studies indicate that there is no essential difference in the atomic mechanism of growth processes in (1) secondary recrystallization, (2) exaggerated or discontinuous grain growth, and (3) controlled recrystallization (strain-anneal technique). Sintering of single crystals of Au and Ag is being studied. An investigation is being made of the plastic properties of single crystals of pure Ag and OFHC copper. Mechanical properties are also being studied using single crystals of dilute binary solid solution alloys, with Cu, Ag, and Al as base materials. The nonuniformity of plastic flow is being investigated in large-grained polycrystalline Al sheet. Extensive data are being compiled on the creep of pure Ag at 200°C in a N_2 atmosphere. (auth)

604

Armour Research Foundation

DEVELOPMENT OF PROTECTIVE COATING FOR TITANIUM AND TITANIUM ALLOYS; JUNE 1−SEPTEMBER 30, 1951; by William H. Colner and Howard T. Francis. [nd] 17p. (WAL-401-46-4; Interim Technical Report No. 1)

This is a report describing research directed toward development of a method to obtain adherent metallic coatings on titanium by electrodeposition. It was found that methods applicable to stainless steel and aluminum were unsuccessful; in fact, it was concluded that any method based on aqueous solutions showed little promise. Completely adherent deposits were obtained from baths containing zinc chloride, hydrogen fluoride, a limited amount of water, and glacial acetic acid as the solvent. Instability of this bath with time dictated a search for other solvents, since it was felt that the solvent was suffering some polymerization. Ethylene glycol gave equally good results but no improvement in stability. Butyl alcohol and methyl alcohol did not give as good results. (auth)

605

THE DIFFRACTION PATTERN OF COLD WORKED METALS: I. THE NATURE OF EXTINCTION. W. H. Hall and G. K. Williamson. Proc. Phys. Soc. (London) 64B, 937-46(1951) Nov.

The influence of crystal perfection on extinction is briefly discussed and the possible corrections given. Experimental results for chemically produced Cu and annealed Al filings have been obtained with a Geiger counter spectrometer using monochromatic radiation. The intensity measurements, and for Cu the experimentally determined particle size, were inconsistent with the views that primary extinction occurred, but could be interpreted wholly in terms of secondary extinction, the corrected f values agreeing within ±2% with accepted values. Evidence to show that annealed metals contain residual lattice strain is advanced, in accord with the dislocation theory, and it is suggested that secondary extinction will predominate over primary extinction in all crystals containing such dislocations. (auth)

606

THE DIFFRACTION PATTERN OF COLD WORKED METALS: II. CHANGES IN INTEGRATED INTENSITY. W. H. Hall and G. K. Williamson. Proc. Phys. Soc. (London) 64B, 946-53(1951) Nov.

Measurements have been made, using a Geiger counter spectrometer, of the changes produced by cold work on the integrated intensities in the Debye-Scherrer spectrum of Al. It is shown that cold work reduces the integrated intensity of all reflections, this decrease being exactly compensated by a rise in the diffuse background scatter, so that the total reflected intensity is unchanged. These results are at variance with those of previous workers, but the discrepancy can be readily explained by the absence of a correction for extinction in previous work. Brief reference is made to measurements of line width, and it is shown that the results support the dislocation theory of plastic deformation. (auth)

607
PRODUCTION OF ALUMINUM-TITANIUM ALLOYS BY ALUMINOTHERMY. Jean Cueilleron and Claude Pascaud. Compt. rend. 233, 745-7(1951) Oct. (In French)

Reduction of TiO_2 by Al powder in the presence of $KClO_3$ gave an Al-Ti alloy containing 45 to 48% Ti and 1 to 3% O; it was not possible to increase the Ti content. Replacement of the $KClO_3$ by BaO_2 led to an alloy containing 65% Ti, 0.02% O, and <0.1% total Fe and Si. The liquid metal separated well, being protected by an extremely hard slag able to scratch tungsten steel. A typical composition of the slag was 7.4% Ti, 15.6% Al, 39.5% BaO, 22.3% TiO_2, and 15.2% Al_2O_3. Playing a jet of O_2 on the surface during the reaction resulted in a high reduction of the TiO_2 but the metal was trapped as globules in the slag. In this latter process the BaO_2 acts as a flux and may be replaced by lime or magnesia.

PHYSICS

608
SIZE AND THERMAL CONDUCTIVITY EFFECTS IN PARAMAGNETIC RELAXATION. Julian Eisenstein. Phys. Rev. 84, 548-50(1951) Nov. 1.

The Casimir-du Pré thermodynamic theory of paramagnetic relaxation (Physica 5, 507(1938)), is generalized by taking account of the thermal conductivity of the paramagnetic salt. The case of a spherical specimen in a constant-temperature bath is considered. One finds that infinitely many times are required to characterize the relaxation when a magnetic field is suddenly applied. The alternating current susceptibility is calculated and is shown to contain terms depending on the size and thermal conductivity of the specimen. A limited comparison of the theory with experimental data is made. (auth)

AEROSOLS

609
Central Aerosol Labs., Columbia Univ.
POLYDISPERSITY AND NUCLEATION IN AEROSOLS; PROGRESS REPORT NO. 2, MARCH 1 - MAY 31, 1950; by Victor K. La Mer. [nd] 8p. (U-12161)

COSMIC RADIATION

610
Puerto Rico Univ.
REPORT ON THE EAST-WEST ASYMMETRY EXPERIMENT OF THE ELECTRONIC COMPONENT OF THE COSMIC RADIATION; by Amador Cobas. Issued Sept. 14, 1951. 11p. (NYO-653)

Progress is reported on installation of test equipment and preliminary measurements of the asymmetry of the electronic components of cosmic radiation. Diagrammatic drawings showing the geometrical layout of the cosmic-ray multitelescope, instrument circuits, regulation of power supply, a hodoscope unit, and a hodoscope camera and hourmeter unit are included.

611
A HIGH ENERGY PROTON-PROTON COLLISION WITH ASSOCIATED EVENTS. V. D. Hopper, S. Biswas, and J. F Darby. Phys. Rev. 84, 457-62(1951) Nov. 1.

An event observed in a nuclear emulsion is interpreted as an incident proton of energy 1000 bev colliding with a hydrogen nucleus and producing a cone of six charged mesons. The presence of three neutral mesons is deduced from two electron pairs and one triplet in the region of the cone. The triplet is due to an electron pair produced by a gamma-ray of energy 24 bev in the field of an electron. An additional electron pair is produced by bremsstrahlung. The kinetic energies of several particles are deduced from scattering measurements and these range from 800 Mev to 17 bev. The total energy of the shower is estimated as 100 bev. In the center-of-mass system the mesons have energies of the order of 400 Mev and an almost isotropic distribution. It is concluded that most of the energy is carried by two neutrons, and only one-tenth of the energy of the primary particle goes to meson production. The results are compared with the theories of multiple meson production. (auth)

612
A SEARCH FOR PRIMARY COSMIC GAMMA-RADIATION. II. LOW ENERGY RADIATION ABOVE AND WITHIN THE ATMOSPHERE. Gilbert J. Perlow and Charles W. Kissinger. Phys. Rev. 84, 572-80(1951) Nov. 1.

Measurements are reported on the intensity of γ rays in the energy range 0.1 to 15 Mev, made in a series of rocket flights. The γ radiation was detected by anticoincidence in a bundle of Geiger counters. Registration of coincidences permitted a measurement of the intensity of charged particles, with the same geometry. The two quantities displayed a simultaneous maximum during flight, the counting rate of charged particles being ten times that of γ rays at the maximum. A diurnal effect was looked for and not found. A theoretical treatment is given of the origin of the γ radiation at the maximum. It is shown to be accountable for by bremsstrahlung of the electronic component and subsequent multiple Compton scattering. An estimate is given of the radiation due to annihilation of positrons followed by Compton scattering. This is shown to be only a few per cent of the bremsstrahlung effect. After all corrections are applied a weak residual γ radiation is found above the atmosphere. Arguments are given for identifying this as an albedo. Two types of albedo are considered, the first and more important is associated with back scattering and is not calculated, while the second is due to the curvature of the earth. A calculation shows the latter to give 25% of the observed counting rate at 82 km. It is concluded that primary cosmic γ radiation contributes at most a very small fraction to the incoming cosmic-ray energy flux. (auth)

613
A CLOUDCHAMBER STUDY OF THE ELECTRONIC COMPONENT OF EXTENSIVE AIR SHOWERS. C. B. A. McCusker and T. E. Nevin. Proc. Roy. Irish. Acad. 54A, 201-205(1951) Aug.

Hazen's method (Phys. Rev. 69, 298(1946)) has been used to find the energy of the electrons occurring in extensive air showers and this energy has been correlated with the density of the showers determined by counting the number of electrons above the top lead plate. The results of the investigation are shown graphically. It follows from the fact that the curve is a straight line that the average energy of the electrons is independent of the density within the range of the densities observed. The average energies of the particles can also be obtained from the curve.

614
OBSERVATIONS OF THE PENETRATING NON-IONIZING COMPONENT OF THE COSMIC RADIATION. J. C. Barton. Proc. Phys. Soc. (London) 64A, 1042-54(1951) Nov.

An anticoincidence arrangement of G-M counters was used to detect that part of the nonionizing component which is capable of penetrating 10 cm of lead. Measurements were made at sea level and at an altitude of 3,560 m. The mean absorption length of the nonionizing particles was found to be 170 ± 5 g/cm^2 in air, 190 ± 35 g/cm^2 in carbon, and 400 ± 25 g/cm^2 in lead. The secondary particles were strongly absorbed in a few centimeters of lead. Studies were made of the angular distribution of the secondaries and of the production of two or more secondary particles in a single process. Less than 0.5% of the nonionizing particles were found to be associated with extensive air showers, but about 10% appeared to be produced by ionizing particles interacting in the lead above the apparatus. The angular distribution of the secondary particles produced in carbon was approximately proportional to cos θ. The nature of the nonionizing particles is discussed, and it is concluded that the only known particles which could explain the results are high-energy neutrons. On this hypothesis, their energy spectrum and intensity at the two altitudes are calculated. (auth)

615
A COMBINATORIAL PROBLEM IN COUNTING COSMIC RAYS. Erwin Schroedinger. Proc. Phys. Soc. (London) 64A, 1040-1(1951) Nov.

The probability is computed that precisely m out of r counters be hit by at least one out of n cosmic particles, each of which has the probability 1/r of hitting any particular counter. The estimation of n from given r and m is discussed.

616
ON THE CALCULATION OF AVERAGE NUMBERS FOR THE ELECTRON-PHOTON CASCADE. Leonie Janossy and Harry Messel. Proc. Roy. Irish Acad. 54A, 217-43(1951) May.

Detailed tables are computed and graphs are plotted for the average number of electrons or photons above a given energy at various depths in a shower. The final results are given to three-place accuracy, but in order to achieve this accuracy it was necessary to calculate the auxiliary functions appearing in the solution to ten places. The tables for the auxiliary functions are also given.

CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE

617
Carbide and Carbon Chemicals Co., K-25
THE APPLICATION OF THE BUERGER PRECESSION CAMERA TO LOW-TEMPERATURE STUDIES; by Robinson D. Burbank and Frank N. Bensey. Issued Nov. 21, 1951. 8p. (K-841)

A method is given which makes use of the complete range of the Buerger precession camera with a precession angle $\mu = 30°$ for crystal-structure studies from room temperature to −180°C. The apparatus is so arranged that substances which crystallize in this temperature interval can be maintained in the crystalline state for indefinite periods.

618
Massachusetts Inst. of Tech.
FUNDAMENTALS OF COLD WORKING AND RECRYSTALLIZATION (Technical Progress Report No. 4, Scope III); by B. L. Averbach, M. Cohen, S. Allen, L. Mager, G. P. Conard, and P. Fopiano. Sept. 30, 1951. 8p. (NYO-859)

Results of studies of atomic displacements in deformed metal are reported. An x-ray technique was used to measure the local displacements in single crystals produced by cold work. Changes in these displacements were observed after various annealing treatments. Another x-ray technique was used to measure the relative disorientations within the single crystals. Calculations of the stored energy after each annealing treatment were made. Data for single crystals of Al, Zn, pure Cu, and Cu-Si alloys are included.

619
THE USE OF SINGLE-CRYSTAL NEUTRON DIFFRACTION DATA FOR CRYSTAL STRUCTURE DETERMINATION. S. W. Peterson and Henri A. Levy. J. Chem. Phys. 19, 1416-9(1951) Nov.

Intensities of neutron reflections from single crystal specimens of several substances have yielded structure factors in close agreement with calculation and with those measured by the usual powder method. Specimens whose dimensions were in the millimeter range were used. Three materials yielded low results, probably because of extinction in the single crystal specimens. The use of single crystal neutron reflections for crystal structure determination appears practical in many cases. (auth)

ELECTRICAL DISCHARGE

620
Utah Univ.
INDUCTION OF A CHEMICAL REACTION IN A HIGH FREQUENCY DISCHARGE; II. FIXATION OF NITROGEN IN A CROSSED DISCHARGE; by William S. Partridge, Ransom B. Parlin, and Bruno J. Zwolinski. Aug. 23, 1951. 11p. (AECU-1771; Technical Report No. III)

In the pressure (100 to 300 mm Hg) and frequency (2.4 to 4.6 Mc) ranges studied the crossed discharge consisting of the high-frequency discharge and a low-frequency (60 cps) discharge across two pairs of copper electrodes set at angles of 90° to each other was more effective than a pure high-frequency discharge in the oxidation of nitrogen. The main product formed was nitric oxide. The yields obtained with a crossed discharge were 50 to 400% higher than the high-frequency yields as the pressure was lowered from 300 to 100 mm Hg. No evidence was found for the existence of critical-electrode, critical-reaction, or "compound" frequencies in the yield vs. frequency curves. (auth)

ELECTRONS

621
A NEW CLASSICAL THEORY OF ELECTRONS. P. A. M. Dirac. Proc. Roy. Soc. (London) 209A, 291-6(1951) Nov.

In the theory of the electromagnetic field without charges, the potentials are not fixed by the field, but are subject to gage transformations. The theory thus involves more dynamical variables than are physically needed. It is possible by destroying the gage transformations to make the superfluous variables acquire a physical significance and describe electric charges. One gets in this way a simplified classical theory of electrons, which appears to be more suitable than the usual one as a basis for a passage to the quantum theory. (auth)

GASES

622

DIFFUSION AS HYDRODYNAMIC MOTION. M. H. Johnson. Phys. Rev. 84, 566-8(1951) Nov. 1.

A phenomenological definition of diffusion in a binary mixture suggests a description of the motion by a hydrodynamic equation which contains a frictional force proportional to the relative diffusion velocity. Plausible assumptions give a set of hydrodynamic equations for any gaseous mixture, which may include charged molecules in a magnetic field. The equations determine the diffusion velocities in terms of the applied forces, the pressure gradients, and the binary diffusion coefficients. The same equations are also derived from kinetic theory in the first diffusion approximation. In higher approximations where thermal diffusion first appears, the equations are no longer valid. (auth)

623

ON EQUATIONS OF THERMAL CONVECTION. P. S. Lineĭkin. Priklad. Mat. i Mekhan. 15, No. 4, 433-8(1951) July-Aug. (In Russian)

624

EQUATIONS OF MOTION OF A VISCOUS GAS. S. V. Vallander. Priklad. Mat. i Mekhan. 15, No. 4, 409-32(1951) July-Aug. (In Russian)

INSTRUMENTS

625

Argonne National Lab.

TECHNIQUES IN THE PREPARATION OF RADIOACTIVE GLASS BEADS, p.66-71 of QUARTERLY REPORT, FEBRUARY, MARCH, APRIL, 1951; DIVISION OF BIOLOGICAL AND MEDICAL RESEARCH; by W. E. Kisieleski, G. Svihla, and A. M. Brues. [nd] 6p. (ANL-4625(p.66-71))

Photographs are presented showing the equipment used in the initial chemical steps that prepare the radionuclide and powdered-glass mixture for firing into glass beads, a closed dry box adapted with a small muffle furnace which permits muffling in a closed system with minimum radiation exposure, equipment used to remove the beads from the furnace into a position allowing separation by sizes and activities, a remote-control closed-system apparatus for separating microscopically the beads from vials into capsules for measurement and final use, and the apparatus used on one of the methods for measuring the activity of the beads by end-window GM counting. Attempts are being made to prepare radioactive beads from pyrex instead of soft glass. 5 figures.

626

Brookhaven National Lab.

RECENT DEVELOPMENTS WITH THE MASS SYNCHROMETER (abstract); by Lincoln G. Smith. Oct. 31, 1951. 1p. (BNL-1021)

The report is reproduced here in its entirety.

Recent work on an instrument for comparing accurately the cyclotron frequencies or periods of ions of nearly equal mass and thus measuring their mass differences will be described. As originally arranged (Smith, Rev. Sci. Instruments 22, 115(1951); Phys. Rev. 81, 295A(1951)) this device has yielded higher resolution than most conventional mass spectrometers and required less critical alignment of component parts. However, intensity obtainable for given resolution is materially lower because of a much lower duty cycle and greater loss of ions per unit path over the longer path used. In recent modifications the velocities of ions are modulated at 180° from the source in a short r-f field rather than one pulsed at a considerably lower rate. Moreover, ions make only two or possibly a few more rotations between source and detector. Thus intensity for given resolution is quite comparable with that of conventional instruments. In fact, with the detector just behind or below the source rather than between it and the modulator, materially larger intensity may be obtainable. It appears, however, that obtaining it requires use of a square wave rather than a sinusoidal modulating field. Comparison of this instrument with others for measuring cyclotron frequencies or periods and with deflection-type spectrometers will be discussed.

627

Columbia Univ.

MANUAL ON THERMOMETRY WITH EMPHASIS ON THERMOCOUPLE TECHNIQUES; by H. Dean Baker. Copyright 1950. 201p. (NP-3526)

628

New York Operations Office

TEST AND EVALUATION OF VIBRATOR POWER SUPPLY; by Robert T. Graveson. Aug. 27, 1951. 3p. (NYO-1568)

Performance curves are given for the Victoreen Vibrator Power Unit Model 517. The unit produces a high voltage and a B plus voltage from an input of only 4.5 v; therefore, it could be used in any application requiring high voltage at a low current and a B plus voltage for a trigger pair or amplifier, i.e., G-M- or photomultiplier-tube circuits.

629

Radiation Lab., Univ. of Calif.

DISCRIMINATOR CALIBRATOR; by Alex J. Stripeika and Gene B. Newton. Nov. 27, 1951. 11p. (UCRL-1576)

A discriminator calibrator which produces pulses of variable but known amplitude with a rep. rate variable from 3 to 400 pps is described and diagramed. A pulse-height discriminator dial can be calibrated in terms of the known input signal from the calibrator. The calibrator unit consists of a relaxation oscillator, a delay line, a pulse shaper, a multivibrator, a pulse-height circuit, a d-c voltmeter, a power amplifier, and a cathode follower. The procedure to be used in calibration is outlined.

630

THE ACCURACY OF POLARIZATION PHOTOMETERS. W. H. Steel. J. Optical Soc. Am. 41, 223-8(1951) Apr.

The accuracy of a polarization photometer is limited by the inherent non-uniformity of polarization due to divergence of the light beams, and by defects in the polarizers. The errors arising from these causes are evaluated and are compared for systems using two or three polarizers in each beam. It is shown that an accuracy of 0.001 is feasible for intensity ratios as great as 1000 to 1. (auth)

631

TRIPARTITE INSTRUMENTATION CONFERENCE—1951. Denis Taylor. Nucleonics 9, No. 6, 5-12(1951) Dec.

The purpose of the Tripartite Instrumentation Conference held in England in April 1951 was to discuss the components, circuits, and instruments in current use on atomic-energy projects in the United States, Canada, and Great Britain, and to consider those planned for future use. The discussions which are reviewed centered, generally, on counting-rate meters, low-background counting apparatus, new techniques for scaling, millimicrosecond techniques, automatic counting apparatus, pulse-amplitude analyzers, and lightweight radiation-monitoring instruments.

632

AMPLITUDE SELECTORS. R. Wahl. J. phys. radium 12, 67A-74A(1951) Oct. (In French)

Pulse analyzers of one, four, and ten channels, composed of two, five, and eleven interchangeable selection elements, are described. These function independently of the wave forms, duration (if $>5 \times 10^{-8}$ sec), and separation (if >12 μsec) of two consecutive pulses and provide flexible and precise regulation of the channel width (1 to 10 v) and of the threshold (5 to 150 v). 15 figures.

633

PREPARATION OF CONCENTRATED INTENSE SOURCES OF P^{32}. J. Lafoucrière. J. phys. radium 12, 826-7(1951) Oct. (Letter to the editor; in French)

Study of P^{32} radiations by the trochoidal method required as near a point source as possible. This was achieved by centrifugation of $NH_4MgP^{32}O_4$ into thin-walled glass needles. The method is not limited as to radioelement or intensity.

634

A COINCIDENCE AND ANTICOINCIDENCE SELECTOR. G. Valladas. J. phys. radium 12, 53A-64A(1951) Oct. (In French)

A selector containing three coincidence channels and one anticoincidence channel is described in detail. Circuits and wave forms are shown. The resolution time may be adjusted between 0.1 and 2 μsec. 26 figures.

635

REDUCTION OF MEASUREMENT TIME IN AMPLIFIERS OF WEAK CURRENTS WITHOUT REDUCTION OF SENSITIVITY. Joseph Taieb. Compt. rend. 233, 785-7(1951) Oct. 8. (In French)

An amplifier circuit having high sensitivity for a given duration of measurement or a short measurement time for a given sensitivity is described.

MASS SPECTROGRAPHY

636

ON THE NEUTRALIZATION OF SPACE CHARGE IN POSITIVE ION BEAMS. René Bernas and Jean-Louis Sarrouy. Compt. rend. 233, 1092-4(1951) Nov. 5. (In French)

Results of experiments show that the effect of space charge in increasing the divergence of an intense positive-ion beam may be reduced by charging the tube surrounding the beam path positive with respect to the source. Electrons produced by ionization of the residual gas (10^{-6} to 10^{-4} mm Hg) then accumulate within the beam, thus neutralizing the positive space charge, rather than drifting to the source and producing x radiation. The application of this method to an isotopic mass spectrometer has given satisfactory preliminary results.

MATHEMATICS

637

HAMILTON'S PRINCIPLE AND THE CONSERVATION THEOREMS OF MATHEMATICAL PHYSICS. E. L. Hill. Revs. Modern Phys. 23, 253-70(1951) July.

A systematic review of the derivations of the equations of motion and the conservation theorems, as they follow from the variational principle, is given. The derivations present an explanation of the variational integral, the functional variation of the integral J, the equations of motion (Hamilton's principle), symmetry transformation of a system, the conservation theorems, the conservation equations of classical mechanics, and the scalar meson field.

MEASURING INSTRUMENTS AND TECHNIQUES

638

RCA Victor Div., Radio Corp. of America

RESEARCH INVESTIGATION OF IONIZATION CHAMBERS; SECOND QUARTERLY PROGRESS REPORT FOR JANUARY 14 TO APRIL 14, 1950; by J. H. Reisner, J. R. Parker, and W. L. McDermid. 1950. Decl. Dec. 4, 1951. 43p. (NP-1567)

In a program for the design and development of ionization-chamber radiation detection and measuring instruments, the laboratory equipment has been completed and is here described. Results of preliminary equipment tests are included.

639

Atomic Energy Research Establishment,
Harwell, Berks (England)

BORON TRIFLUORIDE FOR NEUTRON DETECTION; PREPARATION AND INVESTIGATION OF THE PRODUCT; by F. Hudswell, J. S. Nairn, and K. L. Wilkinson. July 31, 1951. 33p. (AERE-C/R-651)

The preparation of oxygen-free boron trifluoride from the crude cylinder gas is described, with full details of the necessary precautions. Boron trifluoride etherate reacted with calcium fluoride to form $CaF_2.BF_3$, which was then thermally decomposed into calcium fluoride and boron trifluoride. The technique of introducing BF_3 alone or mixed with argon into counters or ionization chambers is described. Tests for impurities were made, and the techniques and results of these tests form the body of the report. The methods of testing included measurements on the mass spectrometer and buoyancy balance. Infrared absorption, vapor-pressure measurements, gas-volumetric analysis, and neutron-counting efficiency were also employed.

640

Argonne National Lab.

MEASURING INSTRUMENTS AND TECHNIQUES, p.195-208 of QUARTERLY REPORT FEBRUARY, MARCH, APRIL, 1951; DIVISION OF BIOLOGICAL AND MEDICAL RESEARCH; Austin M. Brues, ed. [nd] 14p. (ANL-4625 (p.195-208))

The statistics of radioactive-decay counting-rate determinations requiring a preassigned precision with total counting time minimized are discussed. Tables to facilitate such calculations are being prepared. The problem of detecting fast neutrons by proton recoils in the presence of γ rays is being investigated. Pulse-height vs. counting-rate curves are given for a counter consisting of nine 100-μ-thick layers of phenylcyclohexane-terphenyl-diphenylhexatriene solution separated by ⅛-in. lucite sheets. As part of the study of ionization in air from β-ray point sources, a grid-wall ion chamber has been built in the form of a parallel-plate, guard-ring type of chamber. Wall absorption and scattering are minimized by the use of plane grids, and in order to prevent the collecting field from penetrating between the wires, a third and fourth grid are added outside the two principal grids. In order to facilitate the measurements of widely different ion currents, the chamber has been designed so that its volume can be changed from a minimum of about 100 cc to a maximum of about 10,000 cc.

641

Brookhaven National Lab.

A FAST NEUTRON DETECTOR; by W. F. Hornyak. Oct. 17, 1951. 13p. (BNL-1029)

A fast neutron detector with an efficiency of a few per cent and the capability of detecting neutrons in the presence of intense gamma-ray backgrounds has been developed. The detector consists of a ZnS and lucite molded cylinder used in conjunction with a 5819 photomultiplier tube. This detector is well suited to experiments requiring "good geometry" and pulse speeds of the order of 0.1 μsec. (auth)

642

Brookhaven National Lab.

X-RAY MASS DETERMINATION OF UNPROCESSED PHOTOGRAPHIC EMULSIONS; by M. Blau and J. E. Smith. [nd] 11p. (BNL-1030)

A method for measuring the thickness of unprocessed nuclear emulsions based on x-ray absorption is described. The method makes use of the fact that a monochromatic x-ray beam is absorbed in direct proportion to the thickness of the emulsion. When the thickness of the emulsion is known, then the weight/cm^2 can also be determined.

643

[Oak Ridge National Lab.]

CALIBRATION OF THE 4π HIGH PRESSURE ION CHAMBER; by James W. Cobble. [June 1950]. 13p. (CF-50-6-114)

644

Northwestern Univ.

TRAINING MANUAL FOR MICROSCOPISTS MEASURING ALPHA-TRITON TRACES FROM LITHIUM-SIX DISINTEGRATIONS IN PHOTOGRAPHIC EMULSIONS; by J. Haugsnes and J. H. Roberts. Oct. 1951. 21p. (LA-1303)

This manual is written primarily for microscopists who are measuring triton-alpha tracks (Li^6 disintegrations) in photographic emulsions. It deals mainly with the special problems encountered in the study of the Li^6 disintegrations, although some of the instructions apply equally as well to other track studies.

645

Mound Lab.

COUNTING SYSTEMS FOR PULSES OF WIDE DYNAMIC RANGE (Ad Interim Report); by W. H. Baker. Oct. 15, 1951. 38p. (MLM-618)

A radioactive-particle-counting system is described. It consists of a gas-flow, hemispherical, windowless, proportional ionization chamber, an input network, a head amplifier, a main amplifier, a differentiating network, a trigger pair discriminator, a scaler, and a register. It is possible to detect α, β, and γ radiation. Performance curves, circuit diagrams, and photographs of the component units of the system are given. 23 figures.

646

NEPA Div.

SCINTILLATION COUNTING; by Joe Keagy Bair. Mar. 16, 1951. 81p. (NEPA-1645)

This report covers the period from August 1949 to December 1950. The work was directed toward determining the feasibility of using the relatively new scintillation-counting techniques for such purposes as were of interest and value to the NEPA Project. The work covers the successful use of such crystals as anthracene, cadmium tungstate, and sodium iodide plus thallium iodide. An attempt was made to find a lithium-containing crystal which would count satisfactorily; such work includes an attempt by the NEPA Chemistry Group to grow large, clear crystals of lithium iodide. Natural and synthetic lithium-containing minerals were tested when they could be obtained. Certain piezoelectric crystals were tried unsuccessfully. Techniques are given for the preparation of sodium iodide crystals. (auth)

647

NEPA Div.

MULTIPLE CRYSTAL GAMMA-RAY SPECTROSCOPY USING NaI-TlI CRYSTALS; by Joe Keagy Bair, F. C. Maienschein, and William B. Baker. Feb. 13, 1951. 41p. (NEPA-1701)

Instruments and techniques have been developed for a unique response γ-ray spectrometer. With such instrumentation, a curve of intensity vs. energy can be obtained with a one-to-one correspondence between γ rays and peaks in the curve. These instruments utilize up to three sodium iodide–thallium iodide crystals in coincidence and /or anticoincidence. Sensitivities and resolutions obtained are of practical value. (auth)

648

RCA Victor Div., Radio Corp. of America

RESEARCH INVESTIGATION OF IONIZATION CHAMBERS; FIRST QUARTERLY PROGRESS REPORT FOR OCTOBER 14, 1949, TO JANUARY 14, 1950; by J. H. Reisner, J. R. Parker, and W. L. McDermid. [nd] Decl. Dec. 4, 1951. 43p. (NP-1436)

649

RCA Victor Div., Radio Corp. of America

RESEARCH INVESTIGATION OF IONIZATION CHAMBERS; FIFTH QUARTERLY REPORT; NOVEMBER 14, 1950–JANUARY 14, 1951; by J. R. Parker and W. L. McDermid. [nd] Decl. Dec. 4, 1951. 11p. (NP-3026)

650

RCA Victor Div., Radio Corp. of America

RESEARCH INVESTIGATION OF IONIZATION CHAMBERS; FINAL REPORT; OCTOBER 15, 1949–MARCH 31, 1951; by J. R. Parker and W. L. McDermid. [nd] Decl. without deletions Dec. 4, 1951. 104p. (NP-3097)

Co^{60}, Nb^{95}, Cr^{51}, Fe^{55}, Hf^{181}, and In^{114} have been studied in some detail as to their applicability as sources for tests and studies of the response of radiation detection instruments. A "radiation range" has been designed, utilizing four γ sources of energies from 0.18 to 1.3 Mev, for tests of energy characteristics of radiation detection instruments. This "radiation range" permits rapid change of energy of radiation fields. Two test chambers designed for accurate measurement of the ionization properties of gases are described. The ionization properties of the noble gases, as well as air and N, are determined for a wide range of radiation energies and gas pressures. For each gas, relations are shown for specific ionization as a function of gas pressure and energy of radiation. These data include the wall contribution and are shown for both brass and nylon wall chambers. A number of wall materials are investigated theoretically to estimate strength-absorption properties.

651

RCA Victor Div., Radio Corp. of America

RESEARCH INVESTIGATION OF IONIZATION CHAMBERS; FOURTH QUARTERLY REPORT; JULY 14, 1950–NOVEMBER 14, 1950; by J. H. Reisner, J. R. Parker, and W. L. McDermid. [nd] Decl. Dec. 4, 1951. 72p. (NP-3176)

652

RCA Victor Div., Radio Corp. of America

RESEARCH INVESTIGATION OF IONIZATION CHAMBERS; FIRST QUARTERLY REPORT; MAY 1, 1951–JULY 31, 1951; by J. R. Parker. [nd] Decl. Dec. 4, 1951. 46p. (NP-3319)

The need for a monochromatic, low-level, low-energy radiation source is discussed. The merits of known posibilities of meeting or circumventing this need are also discussed and some conclusions reached. In particular it is concluded that the use of fluorescence radiation, in conjunction with the balanced filter method, would be best for this application. The use of a crystal monochromator is rejected because of the dearth of experience at the energy levels concerned and chiefly because of the geometry problem posed when used to evaluate the performance of an ionization chamber. A new test ion chamber is described. This chamber will eliminate the need for disturbing the collecting system each time the wall thickness is varied. Preliminary data taken with this chamber are shown. A study of the wall contribution has been made. Difficulties encountered in completely isolating the wall contribution experimentally are discussed, leading to a theoretical study of the wall contributions. Experimental determination of the wall contribution is considered the more reliable approach because the theoretical study involves many assumptions which do not necessarily obtain in an experimental setup. (auth)

653

New York Univ.

FLUORESCENCE AND CONDUCTIVITY PHENOMENA; FIFTH QUARTERLY REPORT FOR MONTHS INCLUDING

FEBRUARY, MARCH, APRIL. May 1951. 67p. (NP-3504; Progress Report 5)

The fluorescence of solutions under γ and α irradiation has been investigated. The dependence of fluorescence on solute concentration is shown graphically for the following: phenyl α-naphthylamine in xylene, diphenylbutadiene in benzene, and diphenylhexatriene in p-dioxane. The fluorescence, phosphorescence, energy storage, and release of stored energy by light in alkali halide crystals were studied. The shape of the phosphorescent decay does not depend so much on the strength of the preceding irradiation as on the duration of this irradiation. Fast electrons and γ rays appear to react similarly in the alkali halide crystals, but experiments with α particles gave slightly different results. The fluorescent and storage effects are not proportional to each other but are caused by different elementary processes. Preliminary report is made of studies of α- or γ-induced fluorescence and phosphorescence in inorganic phosphors of the ZnCdS type and alkaline-earth sulfides. The apparatus for measuring induced conductivity in inorganic phosphors is described and diagrammed. The investigation has been concerned with the determination of the current induced by ultraviolet light, fast electrons, alpha particles, and γ radiation. It was found that the current is not always proportional to the intensity of the exciting radiation. The influence of infrared light applied in addition to the exciting radiation was also studied. Two effects occur—a stimulating and a quenching effect. They behave quite differently in their dependence on wavelengths and intensities of the exciting radiations. The influence of infrared light applied after the removal of the exciting radiation was also investigated. Theoretical interpretations are discussed.

654

Laboratory for Nuclear Science and Engineering, Mass. Inst. of Tech.

CO_2 IONIZATION CHAMBER TECHNIQUES FOR C^{14} MEASUREMENT; by Gordon L. Brownell and Helen S. Lockhart. [nd] 24p. (NP-3510; Technical Report No. 56)

The utilization of CO_2-filled ionization chambers as sensitive detectors of C^{14} is described. The primary advantage of these chambers is in the larger permissible size of the sample. The theory of the ionization chamber is reviewed with respect to the C^{14}–CO_2 chamber combination. The calibration, ion-pair production, wall absorption, and ionization recombination are discussed and illustrated by graphs. The electrometer charge-rate method for measuring ionization currents of the order of 10^{-17} amp is reviewed as well as that of the high-resistance leak method for larger currents. A general circuit is described which may be used for most special ionization-chamber circuits. The Kirchoff-law solution is given for this circuit, in which two chambers and balancing voltages are used. Modifications to the circuit include the use of a bridge circuit or potentiometer and a vibrating-reed electrometer. Methods are listed for minimizing the major chamber-design problem, that of the stress currents in the center-rod insulator. The design of a 250-cc 300-v chamber is shown. The chamber-filling system consists of an ion trap, vacuum line, and pumping system. The chamber is filled by diffusion or by sweeping the active $C^{14}O_2$ in with inert CO_2. The activity of the gas in the chamber is determined by means of a vibrating-reed electrometer.

655

Radiation Lab., Univ. of Calif.

A γ-RAY DETECTOR EMPLOYING MULTIPLE SCATTERING SEPARATION OF ELECTRON PAIRS; by R. H. Hildebrand, N. Knable, and C. E. Leith. Oct. 24, 1951. 6p. (UCRL-1517)

A simple electron-pair counter has been developed to detect γ rays from the decay of π^0 mesons in the presence of a large flux of neutrons and charged particles. Operation of the counter depends on independent multiple scattering of the electrons in a converter. Two adjacent liquid-scintillator counter telescopes in coincidence detect the scattered electrons. The counting rates obtained with thin converters were found to vary approximately as $Z^2\rho x/A$ where ρ = density and x = thickness. The highest counting rate was obtained with the converter 2.5 cm in front of the phosphor tanks.

656

Radiation Lab., Univ. of Calif.

ELECTRON PICKUP BY FAST C^{12} NUCLEI IN EMULSION (abstract); by Peter C. Giles and Walter H. Barkas. Oct. 1951. 1p. (UCRL-1535)

The report comprises an abstract of a paper for the Dec. 1951 meeting of the American Physical Society at Berkeley and is reproduced here in its entirety.

C^{12} particles, accelerated in the 60-in. cyclotron to about 120 Mev, were detected by D1 nuclear emulsion plates which were subsequently developed in D19 developer. The gap density was measured (Hodgson, Phil. Mag. (7) 41, 725 (1950); Bowker, Green, and Barkas, Phys. Rev. 81, 649 (1951)), as a function of the residual range, on 223 particle tracks. It was noticed that the gap density passed through a minimum at a residual range of about 35 μ, where it is assumed that electron pickup begins. By comparing points on the terminal side of the electron pickup point with points on the initial side of the pickup point of equal gap density, the charge on the particle was estimated as a function of the residual range. It was assumed that the rate of energy loss may be determined from $dE/dR = Z^2f(V)$, where f(V) is determined from proton data, E is the particle energy, R the residual range, and Z the instantaneous value of the charge carried by the ion.

657

Atomic Energy Project, Univ. of Rochester

INSTRUMENTS—RESEARCH AND DEVELOPMENT, p.56-73 of QUARTERLY TECHNICAL REPORT JULY 1, 1951, THRU SEPTEMBER 30, 1951; Henry A. Blair, Director. Oct. 25, 1951. 18p. (UR-189(p. 56-73))

Progress is reported in the construction of a cadmium sulfide crystal detector mounted in a hypodermic needle for in vivo animal radiation studies. The use of one of these units for circulation time measurements in rats is described. Design of an instrument for continuous sampling and recording of air-borne-dust concentration from an inhalation chamber is reported. A continuous strip of filter paper is pulled at a constant rate through an airlock and across a sampling port where the aerosol is filtered from a constant flow of exposure-chamber atmosphere. The paper is brought out through another airlock. A photomultiplier tube scans the blank filter paper before the aerosol deposit is laid down and a second photomultiplier tube scans the strip after the deposit is laid down. Each photomultiplier circuit traces a separate curve on a strip-chart recorder. The design of the circuit is discussed.

658

DISCHARGE MECHANISM IN ARGON COUNTERS. Laura Colli, Ugo Facchini, and Emilio Gatti. Phys. Rev. 84, 606-8(1951) Nov. 1. (Letter to the editor)

The behavior of A counters in proportional and Geiger regions was studied by the authors and reported in Phys. Rev. 80, 92(1950). The results obtained have now been extended, in the case of A of 99.9% purity plus 0.1% CO_2, in both the unstable and the self-sustaining corona regions. Photographs are shown of oscilloscope patterns of β-pulse groups in the Geiger zone, complete bursts in the unstable corona zone from different counters, and detailed shapes of pulse groups of corona bursts. Mechanisms which may account for the shapes of the bursts are briefly discussed.

659
IMPROVED G-M COUNTER FOR LIQUID SAMPLES. P. S. Lavik, H. Harrington, and G. W. Buckaloo. Nucleonics 9, No. 6, 68-70(1951) Dec.

A G-M counter is described which simplifies the assaying of radioactive solutions. The apparatus which accompanies the counter is pictured along with a description of its design. Since the volume of solution and its position in relation to the G-M tube is fixed, the geometry of counting does not vary. The resolving time of the counter permits counting rates up to about 7,000 cpm before deviations from direct proportionality in counting become significant, but as the counting rate exceeds this value a suitable correction must be made. This correction amounts to approximately 3.5% at 10,000 cpm and progressively increases to about 12% at 20,000 cpm.

660
GAMMA-RAY DOSIMETRY WITH POLYVINYL-CHLORIDE FILMS. Ernest J. Henley and Arthur Miller. Nucleonics 9, No. 6, 62-6(1951) Dec.

A dosimeter which combines the advantages of photographic films and chemical systems, has been constructed by casting polyvinyl films in which a methyl-violet dye has been distributed. This dosimeter has been used for calibrating Co^{60} and Ta^{182} sources successfully. The effect of radiation on the film is visually detected; increasing the radiation dosage changes the original violet color of the film first to blue and then to yellow orange. For quantitative estimation of the radiation dose, spectrophotometric measurements are necessary.

661
MULTIPLE SCATTERING OF ELECTRONS IN NUCLEAR EMULSIONS. Dale R. Corson. Phys. Rev. 84, 605-6(1951) Nov. 1. (Letter to the editor)

Extensive calibration measurements have been made in nuclear emulsions by using the Fowler method (Phil. Mag. (7) 41, 169(1950)) for deducing the momentum of a fast particle from its multiple coulomb scattering. The results are presented in terms of the Snyder and Scott multiple-scattering theory (Phys. Rev. 76, 220(1949)). The variation of the scattering constant K as a function of the ratio of kinetic energy to rest energy is plotted for various cell lengths. The "noise" in the measurements was eliminated, and the values obtained for K(100) for 40-, 113-, 196-, and 283-Mev positrons and for 196-Mev electrons are tabulated. A weighted average of all the individual measurements gives $K(100) = 25.1 \pm 0.6$.

662
CALIBRATION CHECKING DEVICE FOR ION-CHAMBER METERS. S. A. Kingsbury. Nucleonics 9, No. 6, 70-1 (1951) Dec.

A device has been developed that permits a rapid accurate check on the calibration of radiation survey instruments to be made without the use of radium standards. This device can be constructed of readily available materials at low cost, and can be operated by nontechnical personnel. Essentially, it consists of a sealed β source (Sr^{90} in equilibrium with Y^{90}) mounted inside the ionization chamber of an instrument. An externally mounted rotary switch places the source in an unshielded position inside the chamber for calibration checking, or rotates it to a shielded position for survey work.

663
SIMPLE EQUIPMENT TO ESTIMATE RADIOCARBON. O. Feldstein and E. Broda. Nature 168, 599(1951) Oct.

A low-pressure argon-alcohol counting tube for radioactive CO_2 is described. The active CO_2 is generated from $BaCO_3$ and $HClO_4$, dried by silica gel, and introduced along with alcohol vapor and argon into the counting tube. The filling system is shown and described.

664
A NEW CONTINUOUSLY SENSITIVE DIFFUSION CLOUD CHAMBER. Daphne Schiff and Pierre R. Gendron. J. Colloid Sci. 6, 495-6(1951) Oct.

A continuously sensitive cloud chamber is described in which the temperature gradient along the walls can be controlled. The purpose of the chamber is to classify nuclei according to the supersaturation they will tolerate, various introduced substances forming self-nucleated clouds at characteristic depths in the chamber.

665
FATIGUE EFFECTS IN SCINTILLATION COUNTERS. L. Reiffel, C. A. Stone, and A. R. Brauner. Nucleonics 9, No. 6, 13-15(1951) Dec.

The effects of fatigue in the photomultiplier on the precision of quantitative results from high-rate counting with scintillators were studied. To insure stable results the total anode current should not exceed 10^{-7} amp. This may best be done by reducing the accelerating voltage or the last 3 or 4 dynodes and plate only, so as to maintain the high resolution accompanying high collecting voltages on the cathode and early dynodes. The loss in gain resulting from this procedure must then be made up by additional amplification after the multiplier. The gain stability required for reproducible integral counting rates is of the order of 0.1%, an order of magnitude higher than that required for differential counting rates since a shift in actual pulse height of $\sim$1% is usually tolerable for differential data.

666
AN IONIZATION CHAMBER WITH BORON CARBIDE-COATED COLLECTOR FOR MEASUREMENT OF THERMAL NEUTRON FLUX. Jacques Labeyrie, Claude Lallemant, and Jacky Weill. J. phys. radium 12, 32A-36A (1951) Oct. (In French)

The collecting electrode of the described ionization chamber consists of three coaxially mounted Al plates, 10 cm in diameter, on both sides of which are deposits of B_4C 2.7 ± 0.5 mg/cm^2 thick. The apparatus is less sensitive but easier to construct than BF_3 chambers. Designed to control atomic piles, the chamber and preamplifier can measure fluxes between 1 and 10^6 neutrons/cm^2/sec. Construction and properties of the chamber and deposition and variations with time of the B_4C are described. 8 figures.

667
CALIBRATION OF GEIGER-MÜLLER LIQUID COUNTERS BY THE RADIOACTIVITY OF POTASSIUM-40. T. A. Chalmers. Nature 168, 870(1951) Nov. 17.

International standardization of G-M liquid counters, calibrated with standard potassium carbonate solutions, is suggested. Need is pointed out for a reliable and convenient radioactive standard, of similar β- and γ-ray energy, easily reproducible, of negligible radioactive decay, and with adequate carrier protection against exchange reactions upon the glass walls of G-M liquid counters. Since X^{40} is present in K to 1 part in 9000 and has a half life of $12.7 \pm 0.5 \times 10^8$ yr with a β ray spectrum of maximum energy 1.38 Mev and a γ ray of energy 1.5 Mev, it is suggested as meeting these requirements. Preparation of a standard potassium carbonate solution and advantages over Co^{60} for standardization of G-M liquid counters are discussed.

668

DESCRIPTION OF AN X-RAY DOSIMETER. Guido Bonfiglioli. Radiologia med. (Milan) 37, 841-5(1951) Oct. (In Italian)

A direct-reading dosimeter with a thimble-type ionization chamber for use during radiotherapy is illustrated and described briefly. Five scales and three ionization chambers give great flexibility in monitoring the irradiation for protection of the patient.

MESONS

669

Radiation Lab., Univ. of Calif.

ANGULAR DISTRIBUTION OF π^+ MESONS PRODUCED IN P-P COLLISIONS (abstract); by Marian Whitehead and Chaim Richman. Nov. 1, 1951. 1p. (UCRL-1530)

The report comprises an abstract of a paper for the Dec. 1951 meeting of the American Physical Society at Berkeley and is reproduced here in its entirety.

The energy spectra of π^+ mesons produced by 341-Mev protons striking H' have previously been measured at 0, 18, and 60° to the proton beam (Cartwright, Richman, Whitehead, and Wilcox, Phys. Rev. 78, 823(1950); 81, 652(1951): Peterson, Phys. Rev. 79, 407(1950); 81, 647(1951)). In order to determine the angular distribution of the mesons more accurately a careful measurement of the production at 35° has been made. As at 0 and 60°, the hydrogen cross section was found by taking a polyethylene carbon difference. The mesons were separated from the proton beam by a magnetic field and were detected at the end of their range by nuclear emulsions embedded in an aluminum absorber. The characteristic peak, which is assumed due to the reaction $p + p \rightarrow \pi^+ + d$, (Crawford, Crowe, and Stevenson, Phys. Rev. 82, 97(1951)) is observed at a meson energy of 48 Mev with a width at half maximum of 4 Mev. The finite width is due to the beam's energy variation and the resolution of the detector. Previously the angular distribution in the center-of-mass system was assumed to be of the form $d\sigma/d\Omega = a(b + \cos^2 \theta_{cm})$, and values of the constants were calculated from the 0 and 60° data (Whitehead and Richman, Phys. Rev. 83, 855(1951)). These data in conjunction with the present results enable one to fix the constants with greater precision.

670

Radiation Lab., Univ. of Calif.

THE YIELD OF NEUTRAL MESONS FROM PROTON BOMBARDMENT OF LIGHT NUCLEI; by R. W. Hales, R. H. Hildebrand, N. Knable, and B. J. Moyer. Nov. 5, 1951. 7p. (UCRL-1543)

The relative cross sections of several light nuclei for neutral-pion production by 340-Mev protons has been measured. Single decay γ rays were detected by independent multiple scattering of the electron pairs in a thick converter. The yield from H^1 appears to be suppressed in accordance with selection rules for a pseudoscalar meson. Relative cross sections were measured as follows: H^1, 0.07 ± 0.06; H^2, 0.85 ± 0.20; Be^9, 5.01 ± 0.12; B^{10}, 4.99 ± 0.11; B^{11}, 5.95 ± 0.13; C^{12}, 6.00 ± 0.16; and O^{16}, 7.46 ± 0.28.

671

Radiation Lab., Univ. of Calif.

PHOTOMESONS FROM DEUTERIUM (abstract); by R. Stephen White, Mark J. Jakobson, and Alvin G. Schulz. Nov. 2, 1951. 2p. (UCRL-1553)

The report comprises an abstract of a paper for the Dec. 1951 meeting of the American Physical Society at Berkeley and is reproduced here in its entirety.

Hydrogen and deuterium gases have been bombarded in a high-pressure low-temperature target by photons from the Berkeley synchrotron to produce charged mesons. The π^+ mesons were detected by trans-stilbene scintillation crystals using $\pi\mu$, $\pi\beta$, and $\pi\mu\beta$ coincidence detection, and both π^+ and π^- mesons were detected with nuclear emulsions. At angles to the beam direction of 135 ± 16°, 90 ± 16°, and 45 ± 16° the ratios of the number of π^- to π^+ mesons were 1.21 ± 0.17, 1.07 ± 0.13, and 0.96 ± 0.11, respectively. No variation of the ratio with meson energy, within statistics, was observed. Absolute values for the π^+ meson energy distribution functions from hydrogen and deuterium in cm², per proton, per equivalent quantum, per Mev, per steradian have been measured and the differential and total cross sections have been obtained by integrating over energy and angle, respectively. The ratios of the cross sections in the lab system from deuterium and hydrogen at each of the detection angles are given in the following tabulation. Errors given are standard deviations due to statistics only. The statistics of the data are not sufficient to compute the proton spin-flip probability from the theory of Chew and Lewis.

$$\left[\frac{d^2\sigma(\bar\theta,\ \bar E_\pi)}{dE_\pi\, d\Omega}\right]_D \Bigg/ \left[\frac{d^2\sigma(\theta,\ E_\pi)}{dE_\pi\, d\Omega}\right]_H \equiv \frac{D}{H}$$

45 ± 16°		90 ± 16°		135 ± 19°	
$\frac{D}{H}$	$\bar E_\pi$ (Mev)	$\frac{D}{H}$	$\bar E_\pi$ (Mev)	$\frac{D}{H}$	E_π (Mev)
0.84 ± 0.17	43	1.04 ± 0.31	42	0.81 ± 0.10	42
0.86 ± 0.13	57	0.75 ± 0.08	55	0.80 ± 0.07	56
0.78 ± 0.14	87	0.78 ± 0.11	70	0.60 ± 0.15	76
		0.68 ± 0.05	75		
		0.58 ± 0.09	94		
$\dfrac{\left[\frac{d\sigma(\bar\theta)}{d\Omega}\right]_D}{\left[\frac{d\sigma(\bar{\bar\theta})}{d\Omega}\right]_H}$	0.81 ± 0.10	0.75 ± 0.05		0.80 ± 0.06	
$\dfrac{[\bar\sigma T]_D}{[\bar\sigma T]_H}$	0.78 ± 0.03				

672

CAPTURE AND SCATTERING OF π^+ MESONS. G. Bernardini and F. Levy. Phys. Rev. 84, 610(1951) Nov. 1. (Letter to the editor)

Ilford G5 plates have been exposed to the π^+ beams of the Nevis Cyclotron. For meson energies of 35 to 50 Mev and 70 to 80 Mev the capture process predominates over scatterings. The energy dependence of catastrophic processes is more evident than was noted for π^- (Bernardini et al., Phys. Rev. 82, 105; 83, 1075(1951)). There is a lack of strongly inelastic scatterings and no stops in flight were observed. Stars with 2 fast-proton prongs represent more than 10% of ~250 π^+ captures. An energy-momentum balance of the π^+ stars allows as an upper limit for $\pi \rightarrow \pi^0$ scattering a cross section not larger than 1/10 of the total scattering cross section. The energy and angular distribution of fast protons emitted in π captures are given.

673

PAIR CREATION BY MESONS. W. Thirring. Proc. Roy. Irish. Acad. 54, 205-16(1951) July.

A complete development of the covariant perturbation theory using methods of Schwinger (Phys. Rev. 76, 790 (1949)), Dyson (Phys. Rev. 75, 486(1949)), and Feynman (Phys. Rev. 76, 769(1949)) is presented. The development is divided in sections entitled Formalism, Creation of Photons by Mesons, and Pair Creation by Mesons. An appendix contains a brief development which shows that the direct nucleon-meson-photon coupling gives the non-relativistic limit the main contribution, while the other possibilities give only relativistic and other small corrections.

674

ON THE MULTIPLE PRODUCTION OF MESONS. H. Umezawa, Y. Takahashi, and S. Kamefuchi. Progress Theoret. Phys. (Japan) 6, 428-9(1951) May-June.

A theoretical investigation is presented of the multiple production of mesons due to nucleon-nucleon collisions. The relation between the energy spectrum of the phenomenologically given c spectrum of the meson cloud and the multiplicity of mesons is discussed.

METEOROLOGY

675

National Physical Lab. (Great Britain)

THE EFFECTS OF VELOCITY AND TEMPERATURE OF DISCHARGE ON THE SHAPE OF SMOKE PLUMES FROM A FUNNEL OR CHIMNEY; EXPERIMENTS IN A WIND TUNNEL; by L. W. Bryant. Jan. 1949. 29p. (ACSIL/49/2482)

676

Massachusetts Inst. of Tech.

RESEARCH ON TURBULENCE AND DIFFUSION OF PARTICULATE MATTER IN THE LOWER LAYERS OF THE ATMOSPHERE; PROGRESS REPORT NO. 6; FEBRUARY 1-APRIL 30, 1950; by E. Wendell Hewson. May 10, 1950. 7p. (NP-3501)

677

New York Univ.

ANNUAL PROGRESS REPORT; AEC AIR POLLUTION PROJECT; METEOROLOGICAL PHASE; by H. A. Panofsky and I. A. Singer. June 30, 1951. 61p. (NYO-1559)

Some meteorological investigations were carried out, mostly at Upton, Long Island, N. Y., for the purpose of gaining a better understanding of characteristics of atmospheric turbulence, especially those characteristics which can be reproduced in a slow-speed wind tunnel. Some of the results lead to recommendations concerning wind-tunnel instrumentation. Eddy heat and momentum-exchange coefficients were obtained by various methods and compared. A crude spectral analysis was made of the stress and kinetic energy, and was compared with a working hypothesis for the characteristics of the vertical velocity spectrum. Instrumentation was designed to obtain the spectrum electronically. The factors governing radical changes of the characteristics of turbulence were investigated by observation and theory. The results lead to recommendations for the tunnel. The variation of wind with height in the lowest 125 meters was analyzed statistically.

NEUTRONS

678

THE DECAY OF NEUTRONS INTO NEUTRAL HYDROGEN ATOMS. S. G. Cohen. Phys. Rev. 84, 591(1951) Nov. 1. (Letter to the editor)

The possibility of decay of a neutron into a neutral H atom by K electron creation has been investigated according to the formula used by Sherk (Phys. Rev. 75, 789(1949)) for decay of tritium into He^3. The ratio of the probabilities of K creation to normal β decay for a neutron is 6×10^{-6}. The recoil energy of the neutral H atom has been calculated as 283 ev on the assumption that a neutrino carries off a unique energy almost equal to the energy of disintegration.

NUCLEAR PHYSICS

679

Argonne National Lab.

A MEASUREMENT OF THE ELECTRON-NEUTRON INTERACTION; by Morton Hamermesh, G. R. Ringo, and Alexander Wattenberg. Nov. 1951. 4p. (AECU-1729; UAC-463)

The electron-neutron interaction has been remeasured by the method of Fermi and Marshall (Phys. Rev. 72, 1139 (1947)). The ratio of intensities of scattered thermal neutrons at 45 and 135° was measured, and the electron-neutron scattering amplitude computed from this ratio. The scattering was measured in Kr, Xe, and A. The interaction is described in terms of a rectangular potential well whose radius is the classical electron radius. The depth V of this well is 4100 ± 1000 ev.

680

Case Inst. of Tech.

NUCLEAR PHYSICS PROGRAM; SEPTEMBER 15, 1950, TO SEPTEMBER 15, 1951. [nd] 32p. (COO-84)

The first section of the report deals with betatron development and instrumentation. A photograph of the new accelerating donut and a block diagram of the system for producing constant peak-energy bremsstrahlung from a field-biased betatron are shown. Observations have been made, with air ionization chambers and with integrating scintillation detectors, of the depth dose due to high-energy radiation in a water phantom. Depth-dose curves are shown. A pair spectrometer is being used as an energy-sensitive detector of γ rays in the measurement of 5- to 15-Mev γ-ray absorption coefficients; coefficients have been measured for Pb and U. The angular distribution of photoprotons from the deuteron has been studied with D_2O-loaded emulsions; experimental histograms are presented. The experimental arrangement being used in an attempt to observe the elastic scattering of high-energy quanta with D_2O-loaded emulsions as γ-ray detectors is diagramed. Theoretical research topics are very briefly surveyed. Most of the work has been reported more completely elsewhere, and a list of publications is included.

681

SHORT RANGE INTERACTION OF ELECTRONS AND FINE STRUCTURE OF POSITRONIUM. Martin Deutsch and Everett Dulit. Phys. Rev. 84, 601-2(1951) Nov. 1. (Letter to the editor)

The separation E between the energies of the lowest bound $^3S_1$ state of the electron-positron system (orthopositronium) and the $^1S_0$ para-state has been measured as 9.4×10^{-4} ev ± 15% by observing the quenching in a magnetic field of the ortho-state which is metastable against annihilation. The relative probability of three-photon annihilation of an ortho-positronium atom is plotted as a function of magnetic-field strength. This experimental value of E is in good agreement with the theoretical value (Pirenne, Arch. sci. phys. et nat. 28, 233(1946); 29, 121, 207(1947)) calculated on the assumption of a short-range spin-dependent exchange interaction associated with virtual annihilation and re-creation of the pair.

682

BOUNDARY CONDITIONS AND TIME-DEPENDENT STATES. Marcos Moshinsky. Phys. Rev. 84, 525-33(1951) Nov. 1.

In a previous paper (Phys. Rev. 81, 347(1951); NSA 5-2969), a phenomenological description of nuclear reactions by means of boundary conditions was introduced. These boundary conditions that connect the several stages of the reaction (initial particles, compound nucleus, etc.) apply to time-dependent, as well as to stationary states. It is possible to discuss then the time development of any state specified initially. In the present paper a time-dependent description is obtained for the single-level S-wave scattering of two spinless particles, and for the process of disintegration of a compound particle. The only parameters on which this time-dependent description depends are the poles of the scattering matrix. The connection between the position of the poles of the scattering matrix in the complex plane, and the time-dependent behavior of the scattering and disintegration processes, is discussed. The form of the transient scattered current is also obtained. (auth)

683
QUANTUM MECHANICS IN FOCK SPACE. Marcos Moshinsky. Phys. Rev. 84, 533-40(1951) Nov. 1.

In the present paper we propose to develop a quantum-mechanical scheme in Fock space (Z. physik 75, 622(1932)) that would describe interactions that take place through the formation of a compound particle. The discussion will be restricted to a dynamical system representing a single-level scattering process. The state of this dynamical system can be found in two stages: initial particles and compound nucleus. The dynamical behavior of this state will be given in terms of a hamiltonian (that has no classical analog) which will be derived from the boundary conditions satisfied by the state. The representation of the dynamical variables, associated with the two stages of the state, will be discussed, and a complete set of constants of motion of our dynamical system will be given. The expansion of an arbitrary Fock state in terms of the simultaneous eigenstates of this complete set of constants of motion, leads to the generalized Hankel transforms. In a representation in which the constants of motion are diagonal, the operator representing the relative kinetic energy of the two initial particles will be nondiagonal, particularly in the neighborhood of the resonance energy. The unitary matrix connecting any initial Fock state with the corresponding state at time t will be obtained, and with its help the time-dependent behavior of the Heisenberg dynamical variables of our dynamical system can be derived. (auth)

684
THE MAGNETIC g-FACTORS OF A NUCLEON. C. Candler. Proc. Phys. Soc. (London) 64A, 999-1002(1951) Nov.

The nuclear magnetic moment is a two-valued function of the spin, and Schmidt's argument is used in reverse to induce the orbital and spin g-factors. g_l is shown to be unity in odd-proton and zero in odd-neutron nuclei, as theory has assumed, but g_s varies from nucleus to nucleus with a mean value about half that found in the free proton or neutron. The magnetic spin ratio G, defined as $g_s/g(p)$ in odd-proton and as $g_s/g(n)$ in odd-neutron nuclei, measures the approach of an empirical moment to a Schmidt line; it is shown to obey much the same rules in odd-proton and odd-neutron nuclei. (auth)

685
PRINCIPAL CONSIDERATIONS IN THE PERIODIC SYSTEM OF THE ELEMENTS. III. Richard Lepsius. Naturwissenschaften 38, No. 20, 472-3(1951) Oct. (Note; in German)

Binomial expressions are given for the shell structures of nucleus and atom. The expansions are compared as to corresponding terms.

NUCLEAR PROPERTIES

686
Radiation Lab., Univ. of Calif.
NUCLEAR CROSS SECTIONS FOR HIGH ENERGY NEUTRONS AND PROTONS (abstract); by R. Jastrow and J. E. Roberts. [nd] 1p. (UCRL-1546)

The report comprises an abstract of a paper for the Dec. 1951 meeting of the American Physical Society at Berkeley and is reproduced here in its entirety.

An earlier study (Jastrow, Phys. Rev. 82, 261(1951)) of nuclear cross sections for neutrons at energies up to 270 Mev has been continued. We find that it is desirable to modify the customary assumption on the density of nuclear matter in order to account for the neutron cross sections over the full energy range from 14 to 270 Mev. As usual, we take the density of nucleons in the nucleus to be uniform within a region whose radius increases roughly as $A^{1/3}$. However, outside this core a diffuse region is assumed in which the nucleon density falls off in a distance of the order of the range of nuclear forces. In the light elements the diffuse region is comparable with the core of constant density, while small compared with this core in the heavy elements. At moderately low energies, of the order of 25 Mev, the diffuse tail is relatively opaque. The increase in total cross section resulting from the tail is greater, relatively, for the light elements than for the heavy elements, and brings the calculated neutron cross sections into better agreement with the observed values at energies between 14 and 40 Mev. At the same time the presence of the diffuse region destroys the diffraction pattern in the elastic cross sections of the light elements while only blurring slightly the diffraction patterns of the heavy elements. This result is also in agreement with recently reported experimental results (Richardson, Ball, Leith, and Moyer, Phys. Rev. 83, 859 (1951)).

687
Radiation Lab., Univ. of Calif.
INFLUENCE OF WELL SHAPE ON THE PICKUP PROCESS IN DEUTERIUM (abstract); by Ira L. Karp. Nov. 1951. 1p. (UCRL-1556)

The report comprises an abstract of a paper for the Berkeley meeting of the Am. Physical Society, December 1951, and is reproduced here in its entirety.

Calculations of the pickup process at high energies in deuterium (Chew, Phys. Rev. 74, 809 (1948)), carried out in Born approximation with an approximate deuteron wave function, exceed the experimental values for 90-Mev incident nucleons by a factor of roughly three to five (Stern, University of California thesis (UCRL-1440)). In an effort to account for this discrepancy the momentum distribution of the deuteron has been recalculated using exponential and square wells fitted to the low-energy data. The results are negative, i.e., all three distributions lie within a few per cent of each other for 90-Mev incident nucleons (although at higher energies the Chew distribution lies well above the other two). It is probable that in the calculation of the pickup process the Born approximation must be especially poor. On the one hand, the pickup process depends on high-momentum components in the deuteron wave function and on correspondingly small separation of the deuteron particles, and, on the other hand, the use of the Born approximation implies that the deuteron particles are far enough apart so that in the scattering by one particle the interaction with the other can be neglected. An estimate of the correction for this interaction is being made.

688
ANGULAR CORRELATION OF THE CONTINUOUS RADIATION ACCOMPANYING BETA-DECAY. L. Madansky, F. Lipps, P. Bolgiano, and T. H. Berlin. Phys. Rev. 84, 596(1951) Nov. 1. (Letter to the editor)

The angular correlation between the β particle and its associated γ quantum has been calculated for allowed and first-forbidden transitions by making use of the tensor interaction and neglecting charge dependence. The angular correlation is plotted as a function of $\cos\theta$ for final β energies of 2, 3, and 3.5 mc^2. The curves demonstrate that the ratio of number of coincidences at the forward peak to that at 90° is greater for the allowed than for the first-forbidden transition. It becomes easier to distinguish between allowed and forbidden as the upper energy of the β spectrum is increased. It is concluded that the internal bremsstrahlung provides a secondary means of studying β decay but does not provide any new information on the form of β-decay interaction.

689

ANGULAR CORRELATION OF THE GAMMA-RAYS OF Cs^{134}. Berol L. Robinson and Leon Madansky. Phys. Rev. 84, 604(1951) Nov. 1. (Letter to the editor)

The γ-ray cascade in Ba^{134} following β decay of the 2.3-yr isomer of Cs^{134} has been investigated. Special coincidence circuits, by means of which coincidences between two signals of proper pulse height were recorded, are described. The 660-kev β (75%) is in coincidence with a 602- and a 794-kev γ. The 90-kev β (25%) is in coincidence with a 568-kev γ, which is followed by the 602- and 794-kev γ rays. Four thousand events were counted at each of three positions, (90°, 135°, 180°). The angular correlation of the γ rays coincident with the 660-kev β ray is in good agreement with the theoretical correlation function for transitions involving spins 4, 2, 0, and quadrupole radiations. The third excited state apparently has spin 5.

690

ELECTRODYNAMIC DISPLACEMENT OF ATOMIC ENERGY LEVELS. Robert Karplus, Abraham Klein, and Julian Schwinger. Phys. Rev. 84, 597-8(1951) Nov. 1. (Letter to the editor)

Modifications in the fine structure and hyperfine structure of hydrogenic atoms, produced by electrodynamic effects, are extended to include effects of order $Z\alpha^2$. These terms arise from a more precise treatment of the nuclear coulomb field in the relativistic domain. The reciprocal of the fine structure constant is now evaluated as $1/\alpha = 137.0346$. The improved theoretical value of the Lamb shift in hydrogen is 1057.75 Mc.

691

ROTATIONAL ENERGY LEVELS OF AN ALPHA-PARTICLE MODEL FOR THE BERYLLIUM AND CARBON ISOTOPES. Richard R. Haefner. Revs. Modern Phys. 23, 228-37(1951) July.

The rotational energy level of an α-particle model for Be^8, Be^9, Be^{10}, C^{12}, C^{13}, and C^{14} is discussed. The validity of the model is established only for the experimental results suggested. The properties of C^{12} are described by the α-particle model, but before the model is considered valid, an analysis of the data on the γ-ray distribution from the transmutation of B^{11} by 163-kev protons must be made. The α-particle model for Be^9 is in accord with the existing experimental data both from energy considerations and from properties of the levels such as angular momentum and parity. The model for the C^{13} nucleus has the three α particles situated at the vertices of an equilateral triangle, as with C^{12}, with the additional neutron having a p-wave function with a node in the plane of the α particles. Aside from moment of inertia caused by the additional neutron, C^{13} is similar to C^{12} in its rotational properties. The symmetry properties are described. The experimental information other than position of excited states is very meager for either Be^{10} or C^{14}; therefore, for these cases, no definite conclusions concerning the applicability of the α-particle model are given.

692

QUADRUPOLE RESONANCE OF Cl^{35} AND Cl^{37} IN p-$C_6H_4Cl_2$. Maurice Buyle-Bodin and Daniel Dautreppe. Compt. rend. 233, 1101-3(1951) Nov. 5. (In French)

Several magnetic resonance experiments at 20°C, 83°K, and 21°K are summarized. The resonance-frequency ratio ν_{35}/ν_{37} in p-$C_6H_4Cl_2$ was found to be the same as that in C_6H_5Cl, indicating the negligible interaction of the electric field of the two Cl atoms. The Cl^{35} line doubled at 21°K, indicating a possible fine structure. The width of the Cl^{35} line at 20°C was measured as 2.7 kc. The mechanism responsible for the difference in line width between Cl, Br, and I is discussed briefly.

693

ON THE ISOTOPE SHIFT IN THE Pd I SPECTRUM AND THE NUCLEAR MOMENT OF Pd^{105}. Peter Brix and Andreas Steudel. Naturwissenschaften 38, No. 18, 431-2(1951) Sept. (Note; in German)

Spectroscopic measurements (not given) show that there is a nuclear volume effect on the isotope shift in Pd, its value fitting well with the effect in Ag and Cd, and that the nuclear spin I of Pd^{105} is greater than ½, most probably 5/2. The nuclear magnetic dipole moment is probably −0.6 nuclear magnetons, corresponding to a $d_{5/2}$ state for the unpaired neutron.

NUCLEAR REACTORS

694

[Oak Ridge National Lab., Y-12 Area]
NUMERICAL INTEGRATION OF THE MULTI-GROUP REACTOR EQUATIONS IN CYLINDRICAL GEOMETRY; by M. C. Edlund. Sept. 27, 1950. 15p. (Y-F5-22)

695

[Oak Ridge National Lab., Y-12 Area]
RESULTS OF A TEST OF THE LINEAR APPROXIMATION MULTIGROUP CALCULATIONS; by D. K. Holmes. Nov. 6, 1950. 6p. (Y-F10-20)

696

EXPERIMENTAL STUDY OF THE CHÂTILLON PILE KINETICS. A. Ertaud, R. Beaugé, H. Fauquez, and L. Vautrey. J. phys. radium 12, 17A-25A(1951) Oct. (In French)

Experimental reactivity curves of the Châtillon D_2O-moderated natural-U reactor are shown. A linear expression for the change in reactivity as a function of three parameters (heavy-water level, position of control rods, and temperature) is given.

697

A METHOD OF PILE OSCILLATION APPLIED TO COMPARISON OF GRAPHITE SAMPLES. A. Ertaud, V. Raievski, and D. Breton. J. phys. radium 12, 784-8(1951) Oct. (In French)

The absorption cross sections of materials which scatter, but only feebly absorb, neutrons are measured by oscillating a sample in the graphite reflector of the D_2O-moderated Châtillon pile. A circuit including an appropriately located BF_3 chamber registers a resultant of the local and total pile flux modulations. The phase difference between this resultant and the movement of the oscillator is a measure of the capturing properties of the scattering material being tested. Impurities in nuclear-quality graphite may be determined to 0.1 ppm of boron.

NUCLEAR TRANSFORMATION

698

Argonne National Lab.
STUDIES WITH THE RANGER (sects. III and IV only); by D. L. Hill. Apr. 14, 1947. Decl. Dec. 5, 1951. 57p. (AECD-3281; CP-3800(sects. III and IV))

The energy distribution of neutrons emitted in the fission of U^{235} has been studied, from 0.27 to 17 Mev, by measuring the ranges of 44,000 protons ejected from paraffin radiators. If there is a principal maximum it is well below 1 Mev. The intensity holds up surprisingly as the energy decreases, but possible experimental errors which might account for this effect are discussed. From 2 to 7 Mev the data conform very well to an exponential with a relaxation energy of 1.55 Mev. Measurements were also made of the energy distribution of α particles from U^{235} and Pu^{239} fission and protons from U^{235} fission. The total cross section for U^{235}-fission α production was found to be 2.5 barns. The cross section for production of protons between 1.4 and 2.1 Mev is 0.1 barn.

699
Atomic Energy Research Establishment, Harwell, Berks (England)
THE $^{12}C(\gamma,3\alpha)$ AND $^{16}O(\gamma,4\alpha)$ REACTIONS AT GAMMA-RAY ENERGIES UP TO 40 MEV; by F. K. Goward and J. J. Wilkins. [nd] 3p. (AERE G/M-100)

The reactions $C^{12}(\gamma,3\alpha)$ and $O^{16}(\gamma,4\alpha)$ have been extensively studied with x rays from the 25-Mev AERE synchrotron and with 70-Mev bremsstrahlung. Preliminary results were printed in Proc. Phys. Soc. (London) 63A, 1171(1950); 64A, 94, 201, 1056(1951), and more conclusive results are now briefly presented in the form of cross-section curves and histograms of levels of C^{12} and Be^8 involved in the photodisintegrations. The graphs emphasize the following phenomena: (1) the doubly peaked cross-section curves and their possible correlation with competing reactions, and (2) the way in which the mechanism of the reactions changes as a function of γ-ray energy.

700
Columbia Univ.
THE PRODUCTION OF LIGHT NUCLEI BY HIGH ENERGY PROTON BOMBARDMENT OF MEDIUM WEIGHT ELEMENTS; by D. H. Greenberg and J. M. Miller. Aug. 28, 1951. 5p. (NYO-811)

Preliminary report is made of the production of light nuclei by 370-Mev proton bombardment of Cu targets 2.5 to 5.0 Mev thick. Cross sections (in barns) for production of light nuclei were measured as follows: C^{11}, 3×10^{-5}; F^{18}, 3×10^{-5}; Na^{24}, 3×10^{-5}; and K^{42}, 5×10^{-5}. The results are compared with those of other experimenters with lower-energy protons on Cu and 370-Mev protons on Co.

701
Radiation Lab., Univ. of Calif.
HIGH ENERGY PHOTOPROTONS FROM CARBON (abstract); by J. W. Rose and W. S. Gilbert. Nov. 1951. 1p. (UCRL-1550)

The report comprises an abstract of a paper for the Dec. 1951 meeting of the American Physical Society at Berkeley and is reproduced here in its entirety.

A study is being made of the high-energy protons ejected from carbon by the 322-Mev bremsstrahlung of the Berkeley synchrotron. The protons are detected by means of a counter telescope consisting of three liquid scintillators each viewed by two or three 1P21 photomultiplier tubes connected in parallel. The protons are required to stop in the second counter, and pulse-height analysis in the first counter is used to differentiate between protons and mesons. $d\sigma/d\Omega$ per equivalent quantum has been measured at 90° in the laboratory. Preliminary results indicate a variation with energy of $1/E^{2.8}$ from 85 to 200 Mev.

702
Radiation Lab., Univ. of Calif.
PHOTODISINTEGRATION OF THE DEUTERON (abstract); by W. S. Gilbert and J. W. Rose. Nov. 2, 1951. 1p. (UCRL-1551)

The report comprises an abstract of a paper for the Dec. 1951 meeting of the American Physical Society at Berkeley and is reproduced here in its entirety.

Photons of a maximum energy of 312 ± 15 Mev in the "spread-out" bremsstrahlung beam of the Berkeley electron synchrotron have been used to disintegrate deuterium. The gas was bombarded in a high-pressure low-temperature target at a pressure of 136 atm and at a temperature of 77°K. The protons from the $D(\gamma,n)p$ reaction were detected by the scintillation-counter-telescope system described [elsewhere]. Since the photoeffect, in the absence of meson production, is a two-body problem, knowledge of a proton's energy and angle in the laboratory system uniquely determines the energy of the x ray responsible for the disintegration. Using this fact, absolute values of $d\sigma/d\Omega$ at several angles were determined for x-ray energies of 200 and 250 Mev in the center-of-mass system, and total cross sections were determined for these energies: σ_t (200 Mev) = $(9.5 \pm 30\%) \times 10^{-29}$ cm^2 and σ_t (250 Mev) = $(13 \pm 40\%) \times 10^{-29}$ cm^2. The indicated probable errors are based on counting statistics alone and give an indication of the limits on the relative cross sections. The absolute cross sections may be in error by as much as a factor of 2. These cross sections are far greater than any smooth extrapolation based on the calculated cross sections at lower energies (Marshall and Guth, Phys. Rev. 76, 1881(1949); 78, 739(1950); Schiff, Phys. Rev. 78, 734(1950)) could yield. One therefore concludes that above the meson threshold the cross section rises sharply with increasing energy.

703
Radiation Lab., Univ. of Calif.
PHOTO-DISSOCIATION OF DEUTERON BY HIGH ENERGY GAMMA-RAYS (abstract); by Seishi Kikuchi. Nov. 2, 1951. 1p. (UCRL-1552)

The report comprises an abstract of a paper for the Dec. 1951 meeting of the American Physical Society at Berkeley and is reproduced here in its entirety.

An analysis was made on proton tracks found in the photographic emulsion which had been exposed by S. White to secondary particles from a deuterium gas target bombarded by high-energy synchrotron gamma rays of maximum energy of about 320 Mev to investigate photomesons from deuterons. The energy spectra of protons at the emission angles of 45, 90, and 135 degrees were obtained. In each case it shows a fairly sharp cutoff at the energies 190, 140, and 95 Mev, respectively. These energies correspond to the energy of the proton expected, if it were produced by the splitting of a deuteron into a proton and a neutron by the absorption of a photon of energy 320 Mev. The angular distribution of protons shows a fairly strong forward asymmetry. The cross section per photon for the photodisintegration increases steeply with the increasing photon energy above the meson threshold. The absolute value of the cross section is of the order of magnitude of the meson production cross section.

704
ALPHA-ALPHA CORRELATIONS IN THE PHOTODISINTEGRATION OF C^{12} AND THE RESONANT ABSORPTION OF ELECTROMAGNETIC RADIATION OF NON-E. D. CHARACTER. Valentine L. Telegdi. Phys. Rev. 84, 600-1(1951) Nov. 1. (Letter to the editor)

Some anomalies encountered in investigations of the photodisintegration of C^{12} with the resonant γ radiation from $Li^7 + p$ are analyzed. A histogram of the energy distribution of the α particles deviates somewhat from the theoretical distribution for $E \lesssim 3.5$ Mev. The appearance of a minimum between 2.0 and 4.0 Mev can be explained on the assumption that the 3.0-Mev level in Be^8 has J = 2, in contradiction to Wheeler's conclusions (Phys. Rev. 59, 27(1941)). Then the α-particle distribution calculated on the assumption of equal absorption cross sections for magnetic dipole and electric quadrupole reproduces all the features of the experimental histogram.

705
BOMBARDMENT OF COPPER WITH TRITONS. D. N. Kundu and M. L. Pool. Phys. Rev. 84, 481-3(1951) Nov. 1.

Tritons have been accelerated to 6.5 Mev in a cyclotron and made to bombard stacks of copper foils. Among the triton-induced reactions, the following have been identified: $Cu^{63}(t,d)Cu^{64}$(12.9 hr), $Cu^{63}(t,n)Zn^{65}$(250 days), $Cu^{65}(t,He^3)Ni^{65}$ (2.6 hr), and $Cu^{65}(t,p)Cu^{67}$ (2.44 days) with relative cross sections for the various reactions as 11 : 64 : 6 : 10, respectively. The Oppenheimer-Phillips process appears to be operative in case of tritons of this order of energy. (auth)

706
PHOTONEUTRON THRESHOLD. R. Sher, J. Halpern, and A. K. Mann. Phys. Rev. 84, 387-94(1951) Nov. 1.

A 25-Mev betatron is used to measure the photoneutron thresholds of 77 isotopes by direct detection of neutron yields as a function of maximum bremsstrahlung energy. The neutrons, moderated in paraffin, are observed with a BF_3 proportional counter and time-delay circuits. Threshold energies for 31 isotopes are repetitions of previously reported values from other laboratories and those for 46 isotopes are either new or more precise determinations. (auth)

707
SLOW-NEUTRON TERNARY FISSION OF URANIUM-235. E. W. Titterton. Nature 168, 581-3(1951) Oct.

More than 1000 cases of ternary fission were observed in Ilford C2 and D1 emulsions impregnated with saturated $UO_2(C_2H_3O_2)_2$ and irradiated in slow-neutron fluxes in the Gleep and Bepo piles at Harwell. Protons occurred, but those of a range greater than 20 μ (1.25 Mev) were not associated with the fission process. Occurrence of negative protons is unlikely. The energy spectrum (of 5 to 29 Mev) and angular distribution of long-range α particles are shown. In this energy range of α particles, 1 three-particle event to 422 ± 50 binary fissions were found. Some short-range fragments with Z greater than 2 seem to be associated with the fission instant. Three-particle fission, in which the light fragment has a range less than 20 μ, occurs at a rate of 1 per 85 ± 10 binary fissions. There is no evidence of fission into 3 approximately equal fragments.

708
ANGULAR DISTRIBUTIONS OF THE NEUTRON GROUPS FROM THE REACTION $^{12}C(d,n)^{13}N$. F. A. El-Bedewi, R. Middleton, and C. T. Tai. Proc. Phys. Soc. (London) 64A, 1055-6(1951) Nov. (Letter to the editor)

At a bombarding energy of 8 Mev, three neutron groups from the reaction $C^{12}(d,n)N^{13}$ have been observed which correspond to the transitions to the ground state and two excited states of N^{13} at 2.38 ± 0.05 and 3.53 ± 0.05 Mev, respectively. The angular distributions of these groups, plotted in the center-of-mass system, together with the theoretical curves calculated on a deuteron stripping theory are shown. For the first and second excited states the best agreement between the theoretical and the observed angular distributions was achieved by assuming the angular momentum of the absorbed proton l_p equal to 0 and 2, respectively. It follows that the first excited state of N^{13} must have spin ½ and even parity, and the second excited state must have spin 5/2 or 3/2 and even parity. For the ground state the general appearance of the angular distribution suggests $l_p = 2$, but this interpretation would involve an excessively large radius of interaction to be used in the theoretical calculation. Fair agreement was obtained by assuming $l_p = 1$, which would indicate this state to be $P_{3/2}$ or $P_{1/2}$.

709
THE REACTION $^{12}C(\gamma,3\alpha)$ AND A 16.9-MEV LEVEL OF ^8Be EMITTING ALPHA-PARTICLES. J. J. Wilkins and F. K. Goward. Proc. Phys. Soc. (London) 64A, 1056-7(1951) Nov. (Letter to the editor)

The $C^{12}(\gamma,3\alpha)$ reaction has been studied in Ilford E1 and C2 emulsions exposed to 70-Mev bremsstrahlung. A total of 180 stars were selected and used to determine the variation of the $C^{12}(\gamma,3\alpha)$ cross section as a function of γ-ray energy, E_γ, up to ~40 Mev. A second maximum in the cross section appears at $E_\gamma \approx 27$ Mev, of ~0.75 of the amplitude of the maximum already known to exist at 18.5 Mev. At 23.5 and 33 Mev the cross section falls to half the value at 27 Mev. Further analysis of the selected stars revealed a 16.9 ± 0.3-Mev excited level of Be^8 which decays by emitting two α particles and whose existence has not been reported previously. This level may be shown to play a predominant part in the formation of the stars at $E_\gamma \gtrsim 26$ Mev. For each star with $E_\gamma \gtrsim 26$ Mev, three values were calculated for the energy E* released when an assumed intermediate Be^8 nucleus disintegrates into two α particles. For eight of the stars an E* value ~0.1 Mev was obtained, indicating probable transition through the ground state of Be^8; the remaining 52 yielded a histogram to which a curve was fitted by assuming that all 52 stars involve a 16.9-Mev excited level of Be^8, of apparent width 1.0 Mev at half maximum. The estimate of 16.9 Mev is unlikely to be more than 0.3 Mev in error, and allowance for limitations of energy resolution (arising particularly from straggling) enables the real width at half maximum to be estimated as less than 0.8 Mev. The 60 stars with $E_\gamma > 26$ Mev hardly provide a sufficient basis for detailed figures of the proportions in which the various Be^8 levels occur. Eight stars probably involve the ground state, and the remaining 52 are consistent with either the 3- or 16.9-Mev excited levels (roughly in the proportion 5 : 47), but other levels are not definitely excluded.

710
ANGULAR DISTRIBUTION OF α-PARTICLES AND PROTONS FROM $Li^6 + D^2$. D. N. F. Dunbar and F. Hirst. Australian J. Sci. Research 4A, 268-83(1951) Sept.

The angular distribution of α particles from $Li^6(d,\alpha)He^4$ has been investigated for deuteron energies between 200 kev and 1 Mev. The distribution may be represented by the expression $N(\theta) = N(90°)[1 + A(E) \cos^2\theta]$, where A(E) is a function of deuteron energy. The variation of A(E) with energy is due to the increasing penetration of the potential barrier by d deuterons. The angular distributions of the two groups of protons from $Li^6(d,p)Li^7$ (γ), Li^7 have been investigated in the same energy range. The distributions are complex and require d deuterons for their complete specification in the form $N(\theta) = a_0P_0 + a_1P_1 + a_2P_2 + a_3P_3 + a_4P_4$, where P_n is the Legendre polynomial of order n. The results appear to resolve some differences apparent in earlier work. There is no evidence that the short-range proton distribution is more complex than that of the long-range group. (auth)

711
FURTHER MEASUREMENTS OF THE ANGULAR DISTRIBUTION OF α-PARTICLES FROM THE $Li^7(p,\alpha)He^4$ REACTION. F. Hirst and R. Uebergang. Australian J. Sci. Research 4A, 284-95(1951) Sept.

The angular distribution of the α particles from the $Li^7(p,\alpha)He^4$ reaction has been measured for a proton energy range 0.3 to 0.9 Mev using scintillation counter technique. A statistical analysis of the observations has been undertaken and results have been compared with those of other experiments. The angular distribution is well represented by the expression $Y(\theta) = Y(90°)[1 + A(E) \cos^2\theta + B(E) \cos^4\theta]$, where A(E) and B(E) are energy dependent parameters denoting the departure from spherical symmetry and implying that p and f protons are important in the reaction.

Curves of A(E) and B(E), of the theoretical form given by Inglis, have been fitted to the combined data of recent experiments analyzed according to the foregoing expression. (auth)

712
HISTORY OF THE DISCOVERY OF ARTIFICIAL NUCLEAR γ RADIATION. R. Fleischmann. Naturwissenschaften 38, No. 20, 465-7(1951) Oct. (In German)

Developments in the elucidation of the nature of nuclear γ emission are recounted briefly. 24 references.

PARTICLE ACCELERATORS

713
Research Lab. of Electronics, Mass. Inst. of Tech.
PARTICLE DYNAMICS IN THE LINEAR ACCELERATOR (Technical Report No. 204); by J. R. Terrall and J. C. Slater. May 31, 1951. 5p. (NP-3502)

Hamilton's equations for the motion of an electron in a linear accelerator are integrated to find the final kinetic energy and phase of an electron injected with arbitrary initial kinetic energy and phase, after traveling down a fixed length of accelerator. The results are expressed in the form of a map of the initial energy-phase space onto a final energy-phase space. This map proves in practice to be very convenient for discussing the actual operation of the accelerator. The curves presented are calculated for numerical values appropriate for the MIT accelerator. (auth)

714
THE ACCELERATION OF ELECTRONS TO ENERGIES ABOVE 10^9 EV. L. Riddiford. Proc. Phys. Soc. (London) 64B, 1013-14(1951) Nov. (Letter to the editor)

Some design characteristics of a 1.3-bev electron synchrotron are suggested. Injection would be at 3 Mev from a linear accelerator and the magnet would be 300 cm in radius and weigh 160 tons, in contrast to the 1000-ton magnet of the Birmingham 1.3-bev proton synchrotron. The smaller magnet could be used to accelerate protons to only 750 Mev.

RADIATION ABSORPTION AND SCATTERING

715
Radiation Lab., Univ. of Calif.
DETECTION OF AZIMUTHAL POLARIZATION IN DOUBLE N-P SCATTERING AT 150 Mev (abstract); by L. F. Wouters. Oct. 1951. 1p. (UCRL-1508)

The report comprises an abstract of a paper for the Dec. 1951 meeting of the American Physical Society at Berkeley and is reproduced here in its entirety.

In order to circumvent the accidental background in the double scattering experiment, the first scattering is performed inside the 184-in. cyclotron tank. LiD and LiH targets are compared in order to obtain the D-neutron contribution to the polarization due to the p-n interaction. The second scattering is performed as an orthodox n-p scattering experiment by paraffin-carbon difference, in the well-collimated neutron beam emerging outside the cyclotron shielding. Four scintillation-counter telescopes are arranged in an azimuthal array observing the second scatterer. Each telescope consists of two photomultiplier liquid-phosphor units; these are operated from a pulsed high-voltage source which is keyed in synchronism with the cyclotron beam pulse. Using selected 1P28 photomultipliers, the counter behavior is indistinguishable from normal d-c operation, when using 100 μ-sec keying pulses at 2 to 2.4 kv. Five- to ten-volt signal pulses are obtained from incident protons, and these are mixed in a current-biased crystal diode coincidence circuit. The system shows an over-all resolution time of 5×10^{-9} sec.

716
Radiation Lab., Univ. of Calif.
FAST PROTONS FROM 270-MEV NEUTRON-DEUTERON COLLISIONS (thesis); by James Warren Hadley. Nov. 5, 1951. 44p. (UCRL-1542)

The yield of high-energy (i.e., n-p collisions with charge exchange) protons from n-d collisions has been compared with the yield of protons from n-p scattering in the same energy and angular interval. The experiment was divided into two main sections, the first being concerned with magnetic-particle-spectrometer measurements of differential yields as a function of angle and energy, and the second with counter-telescope measurements of yield as a function of angle, integrated over all energies above $200 \cos^2 \theta$ Mev. The experimental results are described in terms of two main features: first, that the energy spectrum of the fast protons produced at small angles in n-d collisions is a fairly close reproduction, in form, of the energy spectrum of the incident neutrons; and second, that the yield of all protons of energy greater than $200 \cos^2$ Mev, from n-d collisions, bears at each scattering angle the ratio of about 0.7 to the yield of protons having energy greater than the same cutoff energy from n-p collisions. Consideration is given to the effect of the motion of the proton within the deuteron and to the Pauli exclusion principle.

717
Radiation Lab., Univ. of Calif.
ELASTIC SCATTERING OF 190-MEV DEUTERONS BY PROTONS (abstract); by Martin O. Stern. Nov. 2, 1951. 1p. (UCRL-1554)

The report comprises an abstract of a paper for the Dec. 1951 meeting of the American Physical Society at Berkeley and is reproduced here in its entirety.

Experiments on elastic scattering of the 184-in. cyclotron's 190-Mev deuterons reported earlier (Bloom and Stern, Phys. Rev. 81, 660(1951); 83, 178(1951)) while in progress, have been completed. Differential scattering cross sections between 15 and 170° in the center of mass have been measured by the polyethylene-carbon subtraction method in stilbene scintillation counters feeding fast amplifiers. The range 40 to 160° was covered by observation of coincidences between the deuteron and its partner proton. The intervals 15 to 45° and 150 to 170° were covered with a single crystal preceded by aluminum absorber. The change in hydrogen effect with varying absorber was observed. An elastic scattering cross section between 10 and 180° of $(29 \pm 3) \times 10^{-27}$ cm^2 was obtained. Agreement with the theory of Chew (Phys. Rev. 74, 809 (1948)) is excellent for the range 50 to 120°. At smaller angles the observed effect is about 0.7 of the calculated one; in the "pickup" region near 180° a peak is found which is a factor of 5 lower than that theoretically predicted.

718
Radiation Lab., Univ. of Calif.
EFFECT OF CHEMICAL STRUCTURE ON STOPPING POWERS FOR HIGH ENERGY PROTONS (abstract); by T. J. Thompson. Nov. 2, 1951. 1p. (UCRL-1555)

The report comprises an abstract of a paper for the Dec. 1951 meeting of the American Physical Society at Berkeley and is reproduced here in its entirety.

The stopping power of various organic compounds relative to copper is being measured for protons of mean energy 270 Mev. The compounds selected consist of C, H, N, O, and Cl in various combinations so that possible structural effects on the stopping power may be observed. The sample thickness is selected so as to reduce the energy of the beam from 340 Mev to approximately 200 Mev. The remainder of the proton range is dissipated in copper absorbers of variable thickness. Ionization chambers before and behind the absorber column are used to obtain Bragg curves of absorber thickness vs. relative ionization in the usual manner. It is known that the stopping power of a compound is very nearly an additive function of the stopping power of the elements making up the compound. The relative stopping power at 270 Mev, while not strictly additive, is, in the cases tested, additive within the accuracy of most nuclear experiments. There appears to be, however, a measurable deviation from additivity. Preliminary results, which must be further verified, indicate that unsaturated compounds (e.g., benzene) have slightly higher stopping power than would a mixture of graphite and saturated compound (e.g., cyclohexane) of the same atomic constitution. Details will be discussed. Experiments with other compounds and solutions and the liquid gases are being carried out.

719

UPPER AND LOWER BOUNDS OF SCATTERING PHASES. Tosio Kato. Progress Theoret. Phys. (Japan) 6, 394-7 (1951) May-June.

A general method is developed for a rigorous estimation of upper and lower bounds of scattering phases in the variational methods applied to one-dimensional problems. It is also possible to estimate the mean error of the approximate wave function itself. An essential point in the method is the evaluation of mean square ^{2} of the left-hand side of the wave equation with respect to a weight function chosen appropriately. Also, we have need of certain auxiliary constants, α, β defined in connection with an eigenvalue problem associated with the wave equation. However, only a rough estimate is required of these quantities, and some general methods are given for their estimation. As a example, the scattering of slow electrons by hydrogen atoms is treated in the one-body approximation. It turns out that phases are determined rigorously with the possible errors of 10^{-3} or 10^{-4} by assuming a very simple trial function containing only two parameters, and that the approximate wave function is also exact within about 10^{-2}. (auth)

720

THE SCATTERING OF NEUTRONS BY DEUTERONS AT HIGH ENERGIES. B. H. Bransden. Proc. Roy. Soc. (London) 209A, 380-96(1951) Nov.

Born's approximation has been used to calculate total elastic and inelastic cross sections and angular distribution for the scattering of neutrons by deuterons at incident energies of 100, 200, and 300 Mev. The nuclear potential has been taken to be a mixture of central and noncentral interactions of the type $V_{12} = I_{12}(1-\frac{1}{2}g+\frac{1}{2}g\sigma_1\sigma_2+\gamma S_{12})\ V(r)$, where $S_{12} = r^{-2}3\sigma_1.r\sigma_2.r-\sigma_1.\sigma_2$. Four types of isotopic factor I_{12}, giving exchange properties of the neutral, charge exchange, symmetrical and Serber theories, have been investigated. The effect on the scattering of including the D wave of the ground state of the deuteron has been estimated. (auth)

721

THE DIFFRACTION OF THERMAL NEUTRONS BY SINGLE CRYSTALS. G. E. Bacon. Proc. Roy. Soc. (London) 209A, 397-407(1951) Nov.

Experimental measurements of the intensity of neutron reflection by large single-crystal slices are shown to be in agreement with previously published calculations. It is demonstrated that accurate comparison can be made of the structure factors of planes in a zone by the use of cylindrical or pillar crystals, sufficiently small in diameter to give negligible secondary extinction effects. The use of single crystals for structure analysis is discussed. (auth)

722

LOSS OF ENERGY BY CHARGED PARTICLES IN A HIGHLY IONIZED MEDIUM (ION PLASMA). Bernard Kwal. J. phys. radium 12, 805-10(1951) Oct. (In French)

In order to take account of the interference of free electrons with a particle traversing a highly ionized milieu it is considered that the only limiting condition on the freedom of these electrons is the possibility of their incorporation in the free oscillations of the plasma, as envisaged by Langmuir. The formulas of Bohr and Bethe are thus transformed in this case by considering, respectively, the Langmuir frequency instead of the interatomic frequencies, and the energy of the quantized harmonic oscillator instead of the average excitation potential of the atom. Since the interaction potential in the interior of the plasma is not coulombic, it is necessary to modify the equations, by using the Rutherford-Mott relation, to take account of the screening effect. On the basis of some numerical results, the application of the formulas to the interstellar origin of cosmic rays and the possibility of experimental verification in electric arcs of high current density are considered.

723

A SEARCH FOR SUDDEN LARGE CHANGES OF ENERGY OF BETA-RAYS IN A CLOUD CHAMBER. W. T. Davies and D. F. Shaw. Proc. Phys. Soc. (London) 64A, 1006-12(1951) Nov.

Measurements are presented of the changes of curvature of β-ray tracks in a cloud chamber containing air at approximately N.T.P. situated in a magnetic field of 400 gauss. These are examined for evidence of processes involving the reversible production of electrons of rest mass, a small multiple of the normal value. Indications from a study of earlier investigations, that such processes might exist, are not substantiated, and the results confirm and extend those of Bleuler. It is shown that this type of cloud chamber investigation is unsuitable for obtaining useful information on inelastic scattering of fast β-particles, and that multiple scattering and observational bias are adequate to explain the anomalies previously reported. (auth)

724

TOPICS IN SCATTERING THEORY. G. Breit. Revs. Modern Phys. 23, 238-52(1951) July.

Some questions in scattering theory which arose in the treatment of experimental material on p-p and p-n scattering are discussed. The variational method as carried out in the literature is shown to be more involved than the direct solution. In this connection it is shown that the function f of Briet, Condon, and Present can be expanded in powers of the energy by a general and simple procedure and that simple formulas for the general coefficient can be given. The expansion can be made around any energy, and the range of applicability of the method can be extended beyond the energy at which the series about the energy E = 0 stops converging. Related expansions are given for the effect of linear parameters entering the potential energy. The advantages and disadvantages of the f plots are considered.

725

ACTUAL PATH LENGTH OF ELECTRONS IN FOILS. C. N. Yang. Phys. Rev. 84, 599-600(1951) Nov. 1. (Letter to the editor)

The distribution due to multiple scattering of a beam of charged particles after passing through a foil is calculated with respect to the actual path length $(t + \Delta)$ of the particles. The general solution obtained can be used to compute the probability $A(\Delta)d\Delta$ that the charged particle has, in a foil of thickness t, a path length between $t + \Delta$ and $t + \Delta + d\Delta$. The final result for two common cases is given. A method is given for computation of the average value of Δ without first solving for the complete distribution with respect to path length.

726

ON THE THEORY OF COHERENT SCATTERING PROCESSES IN LIQUIDS. Louis Goldstein. Phys. Rev. 84, 466-75(1951) Nov. 1.

The coherent scattering structure factor of liquids for x rays and slow neutrons is shown to determine completely both the correlation function and the direct local interaction function of liquids, which quantities are the only operating elements of the general static liquid model of Ornstein and Zernike. Of these functions, only the former has been derived so far from the data accumulated essentially on the coherent scattering of x rays by liquids. It is shown that the directly available experimental structure factors completely determine the even moments of these molecular distribution functions. The zeroth moment of the correlation function augmented by unity is essentially the liquid concentration fluctuation which determines its isothermal compressibility. These quantities become thus directly derivable from the structure factor measurements without any arbitrary and uncertain manipulations. In terms of the model, a straightforward method leads, with the empirically obtainable total cross section, to the total incoherent slow-neutron-scattering cross sections in liquids. These should yield information on their energy spectrum not available through other types of scattering processes, for instance such as x rays. (auth)

727

VARIATIONAL SCATTERING THEORY IN MOMENTUM SPACE. I. CENTRAL FIELD PROBLEMS. Walter Kohn. Phys. Rev. 84, 495-50(1951) Nov. 1.

Variational principles for scattering problems in a central field are formulated in momentum space and studied in detail. The method allows of generalization to collisions of composite particles, including disintegrations into more than two end products. (auth)

728

ELASTIC SCATTERING OF PHOTONS BY NUCLEI. J. S. Levinger. Phys. Rev. 84, 523-4(1951) Nov. 1.

The cross section for nuclear resonance scattering is estimated for the case when the photon energy is far from resonance with the excitation energy for any level of the scattering nucleus. For photon energy much less than 15 Mev it is found that the cross section depends on the fourth power of the photon energy, and is very much smaller than the nuclear Thomson cross section for photon scattering by the nucleus as a whole.

729

SCATTERING OF NEUTRONS BY PROTONS AT HIGH ENERGIES. D. Basu. Indian J. Phys. 25, 246-56(1951) May.

It is shown that the recent experimental results on the n-p scattering at 260-Mev energy favors the Möller-Rosenfield interaction and rules out the pseudoscalar theory. Contrary to the general expectation that the Born approximation is valid before the influence of the radiation reactions needs to be taken into account, it is found that the Born approximation, which is reasonably valid for 260-Mev energy, gives a theoretical value twice as large as the experimental one, but the inclusion of the radiation damping term brings the theoretical value in good agreement with the experimental result. (auth)

RADIATION EFFECTS

730

THE PHOTOGRAPHIC ACTION OF X-RAYS. J. R. Greening. Proc. Phys. Soc. (London) 64B, 977-92(1951) Nov.

The variation of photographic blackening with intensity, exposure, the thickness of material round the film, the angle of incidence, and the wavelength of x-rays are examined theoretically and, with one exception, experimentally. A detailed theoretical investigation is made of the energy absorption in the silver bromide grains, consideration being given to the energy lost by scatter and fluorescence and to the electron interchange between the silver bromide grains and the surrounding gelatine and other material. It is concluded that for the majority of emulsions there will be no variation of blackening with x-ray intensity and that the photographic density will be proportional to the exposure at low densities. At very short wavelengths the blackening is critically dependent upon the thickness of material round the emulsion. Photographic density decreases with increase of angle of incidence of x-rays, the maximum decrease observed being about 17%. Within the wavelength range examined experimentally (0.020 to 0.354 A) the photographic density was approximately proportional to the energy absorbed by the silver bromide. The density per roentgen varied by a factor of 42 in this range. The variation of density per roentgen with wavelength and angle of incidence limits the applications of photographic methods of x-ray measurement. Methods by which emulsion manufacturers can reduce these variations are suggested. (auth)

RADIOACTIVITY

731

[Metallurgical Project. Univ. of Chicago]
TIME VARIATION OF PERCENT DISTRIBUTION OF FISSION ACTIVITY IN BOMBARDED URANYL NITRATE; by E. L. Brady and C. D. Coryell. May 19, 1943. Decl. with deletions Dec. 11, 1951. 4p. (AECD-3283; CC-643)

732

Metallurgical [Lab.]; [Univ. of Chicago]
CHEMICAL RESEARCH—RADIOCHEMISTRY; REPORT FOR MONTH ENDING APRIL 17, 1943; J. Franck, Director. [nd] Decl. with deletions Dec. 11, 1951. 21p. (AECD-3284; CC-579)

A continuation of the detailed analysis of β and soft and hard γ activity associated with all fission product elements in a nitrate bombardment is presented. The "cooling" time has been extended to 170 days. The data for the individual elements are presented in tables as counts/min and in figures as percentage of total β, soft γ, and hard γ radiations. Calculations and graphs have been made on the heat generated by the longer-lived fission products. The method of analysis is presented. Two new short-lived Rh fission product activities have been found. They are probably the daughters of the two long-lived Ru activities (30 and 200 days). Re-evaluation of data on Tc leads to the conclusion that the longest-lived Tc activity in measurable yields is the 6.1 hr (formerly 6.6 hr). New parent-daughter relationships in the rare-earth activities are given. Theoretical β-absorption curves have been made using the Fermi distribution function and linear absorption curves for small energy intervals. A Feather analysis of the absorption curve leads to the theoretical maximum energy. (auth)

733

Brookhaven National Lab.
THE EFFECT OF CHEMICAL COMBINATION ON THE INTERNAL CONVERSION IN Tc; by J. C. Slater. [nd] 5p. (BNL-1020)

It was found experimentally by Bainbridge, Goldhaber, and Wilson (BNL-1031) that the probability of internal conversion of the 2-kev isomeric transition in Tc^{99} depends on the state of chemical combination. The effect of chemical combination on the wave functions of the electrons which may be involved has now been investigated theoretically. Rough calculations have indicated that squeezing of the 4p shell and possibly of the 4d shell could increase the charge density enough to account for the observed change in the metal and in $KTcO_4$.

734
Brookhaven National Lab.
INFLUENCE OF THE CHEMICAL STATE ON THE LIFETIME OF AN ISOMER; by Kenneth T. Bainbridge, M. Goldhaber, and Elizabeth Wilson. Oct. 25, 1951. 4p. (BNL-1031)

It has been found that the decay constant λ of the highly converted 2-kev isomeric transition in Tc^{99} assumes different values for different chemical states of the element. When long-lived Tc^{99} is used as a carrier, λ for Tc^{99m} in $KTcO_4$, as the dry salt, is $1 + 0.0030 \pm 0.00010$ times greater than λ for Tc^{99m} electrolytically deposited on Cu. The same value, within the expressed error, was found for $KTcO_4$ in basic aqueous solution. λ for Tc^{99m} as the sulfide is $1 + 0.00031 \pm 0.00012$ times greater than λ for Tc^{99m} electrolytically deposited on Cu. The measurements were made by the Rutherford balance method in which two identical ionization chambers housing the sources under comparison are connected to collect ions of opposite sign.

735
Ames Lab.
SHORT-LIVED SYNCHROTRON-INDUCED RADIOACTIVITIES; by Forrest I. Boley and D. J. Zaffarano. July 1951. 73p. (ISC-154)

The use of a scintillation spectrometer for measurement of the energy distribution and half life of short-lived β emitters is described. The high energies of the β spectra associated with short-lived radioactivities permit the attainment, for energies above 3 Mev, of an instrumental resolution better than 10%. The short-lived radioactivities studied were divided into two groups: In the first group are those isotopes with half lives of the order of minutes while in the second group are those of the order of seconds. The first group consisted of Pr^{140} and Fe^{53} with the obtained end points of 2.35 ± 0.10 Mev and 2.60 ± 0.10 Mev, respectively. The results obtained for the end points and the half lines for the second group are shown in the following tabulation.

Nuclide	β end point (Mev)	Half life (sec)
Na^{21}	2.53 ± 0.10	27.0 ± 4.0
Mg^{23}	2.99 ± 0.10	12.3 ± 0.4
Si^{27}	3.48 ± 0.10	5.4 ± 0.4
S^{31}	4.06 ± 0.20	3.2 ± 0.3
Cl^{33}	4.43 ± 0.20	1.8 ± 0.1
K^{37}	4.57 ± 0.20	1.2 ± 0.2
Ca^{39}	5.13 ± 0.20	1.1 ± 0.2

The spectrum and decay rates for the nuclides are listed are shown graphically. The spectrum of $Sr^{90}-Y^{90}$ is also given.

736
Radiation Lab., Univ. of Calif.
L ELECTRON CAPTURE AND ALPHA DECAY IN Np^{235}; by Ralph A. James, Albert Ghiorso, and Donald Orth. Oct. 24, 1951. 7p. (UCRL-1514)

Ten grams of enriched U^{235} have been bombarded with 20-Mev deuterons and the radiations of Np^{235} have been studied. Np^{235} decays by α emission (0.005%), K capture (<10%) and L capture (>90%). The α particles have an energy of 5.06 ± 0.02 Mev (disintegration energy 5.15 Mev). The disintegration energy for the reaction $Np^{235} + e^- = U^{235}$ is calculated as 0.26 Mev from a closed-cycle system. The half life of Np^{235} is 410 ± 10 days.

737
Radiation Lab., Univ. of Calif.
ALUMINUM−24; A DELAYED HEAVY-PARTICLE EMITTER (abstract); by Ann C. Birge. Nov. 1, 1951. 1p. (UCRL-1547)

The report comprises an abstract of a paper for the Dec. 1951 meeting of the American Physical Society at Berkeley and is reproduced here in its entirety.

The beam of the 32-Mev linear accelerator was run through a proportional counter and into its Mg wall. A delayed heavy-particle activity was observed with a half life of 2.3 ± 0.2 sec, and a threshold of 15.4 ± 0.3 Mev. By a consideration of the energy available, it can be shown that the only possible heavy-particle emitter that can be formed with this threshold energy from a stable Mg isotope is Al^{24}. The reaction is Mg^{24} (p,n) Al^{24}. The mass of Al^{24} calculated from the threshold energy is 24.0075. As in the other delayed α-particle emitters reported previously by Alvarez (Phys. Rev. 80, 519(1950)), the observed lifetime is that of the β decay that precedes the heavy particle. The energy available in this case would allow either a proton or α-particle to be emitted, but there is more energy available for the latter.

738
ON THE MATRIX ELEMENTS OF THE BETA DECAY. Mituo Taketani, Seitaro Nakamura, Ken-ichi Ono, and Minoru Umezawa. Progress Theoret. Phys. (Japan) 6, 286-94(1951) May-June.

ft values of β decay for forbidden transitions are classified according to the experimental spectra. They are found to fall into distinct groups, if the correct formula for the forbidden probabilities of Fermi theory worked out by Nakamura, Shima, and Kobayasi (J. Phys. Soc. (Japan) 4, 166(1949)) are adopted. The possible selection rules, and the conditions for the uniqueness of the matrix elements adopted, are also discussed. From the results, interaction types of the Fermi theory could be limited to some extent. (auth)

739
ADDITIONAL DATA ON THE RADIOACTIVE ISOTOPES OF TIN AND TELLURIUM. J. M. Cork, A. E. Stoddard, C. E. Branyan, W. J. Childs, D. W. Martin, and J. M. LeBlanc. Phys. Rev. 84, 596-7(1951) Nov. 1. (Letter to the editor)

Spectrometric studies of pile-irradiated Sn and Te specimens have yielded results differing from those previously reported. Sn^{113} was found to decay by K capture to In^{113} with a half life of 118 ± 2 days; three γ transitions in In^{113} with energies of 393.3, 255.2, and 400.9 kev are associated. An excited state of Sn^{117} of half life 14.0 ± 0.5 days was produced by neutron capture in Sn^{116}; two γ rays of energy 155.9 and 159.4 kev were indicated. An^{123} is a β emitter of half life 125 ± 3 days; no γ radiation appears to be associated. Half lives and γ energies in Te were measured as follows: Te^{121}, 140 days, 81.8 and 213.6 kev (and 575 kev in Sb^{121}); Te^{123}, 121 days, 88.7 and 159.2 kev; Te^{125}, 58 days, 109.6 and 35.3 kev; Te^{127}, 115 days, 88.7 kev; and Te^{129}, 33.5 days, 106.0 kev.

740
NUCLEAR SHELL MODEL AND THE β-DECAY SCHEMES, I. Minoru Umezawa, Seitaro Nakamura, Yoshio Yamaguchi, and Mituo Taketani. Progress Theoret. Phys. (Japan) 6, 408-25(1951) May-June.

A summary of Mayer's shell model is given. The spin-orbit-coupling shell model is introduced for nuclei with even mass number as well as for the odd mass nuclei. It is shown that the over-all agreement between Mayer's shell model and the Fermi theory of β decay is very satisfactory and that the type of nuclei predicted by the spin-orbit shell theory is useful for the study of analysis of β-decay schemes and nuclear spectroscopy.

741

SPECTROMETRIC STUDY OF THE γ RADIATION OF As^{76}. P. Hubert. J. phys. radium 12, 823-4(1951) Oct. (Letter to the editor; in French)

The following measurements have been made of the γ rays of a 10-mc source of 26.7-hr As^{76}, using the β-ray spectrometer previously described by the author (J. phys. radium 12, 763(1951)).

	Energy (in Mev)		Relative intensity	
γ Ray	Compton	Photoelectron	Compton	Photoelectron
1	0.550	0.555 ± 0.002	1	1
2	-	0.648 ± 0.002	0.07 ± 0.04	0.095 ± 0.01
3	1.17	1.210 ± 0.005	0.21 ± 0.04	0.25 ± 0.02
4	1.4	1.410 ± 0.006	0.014 ± 0.005	0.016 ± 0.004
5	2	2.06 ± 0.01	0.04 ± 0.01	0.055 ± 0.01

The definite absence of the 1.7- or 1.8-Mev γ ray reported by several authors is noted.

742

GAMMA RAYS OF Cs^{134}. V. S. Shpinel. Zhur. Eksptl'. i Teoret. Fiz. 21, No. 7, 853-5(1951) July. (Letter to the editor; in Russian)

The γ-ray spectrum of Cs^{134} has been measured with a β-ray spectrometer previously described by the author (Shpinel, Zhur. Tekh. Fiz. 20, 834(1950); NSA 5-3725). The following γ-ray energies (in kev) were found, the figures in parentheses being relative intensities: K_1, 569 ± 5 (0.35 ± 0.09); L_1, 571 ± 5; K_2, 601 ± 4 (0.94 ± 0.24); L_2, 601 ± 7; K_3, 794 ± 7 (1.0); L_3, 793 ± 7; K_4, 1024 ± 10; K_5, 1110 ± 10; and K_6, 1347 ± 14 (0.017 ± 0.008). 2 figures.

SPECTROSCOPY

743

ISOTOPE SHIFTS IN THE SPECTRUM OF HELIUM. L. C. Bradley and H. Kuhn. Proc. Roy. Soc. (London) 209A, 325-33(1951) Nov.

The isotope shift in fourteen singlet lines and four triplet lines of helium was measured interferometrically. Extrapolation of the change of the shift within each series allowed the isotope shift of the terms to be determined. The shifts in the higher ^1D terms were found to show anomalies which are ascribed to perturbations and hyperfine structures. The results of this work in conjunction with measurements by Fred, Tomkins, and Brody lead to the conclusion that the values of the isotope shifts given by the theory of Hughes and Eckart are too small throughout by amounts up to 20%. (auth)

THEORETICAL PHYSICS

744

GAUGE-INDEPENDENT QUANTUM ELECTRODYNAMICS. Frederik J. Belinfante and John S. Lomont. Phys. Rev. 84, 541-6(1951) Nov. 1.

A covariant, but not manifestly covariant, form of quantum electrodynamics is discussed. No gauge-dependent potentials are introduced as independent (canonical) variables. Only the transverse electromagnetic field is quantized as a photon field. We formulate the theory first in interaction representation, although only flat space-like surfaces σ are considered. The interaction operator is then used for describing Lorentz transformations (rotations of σ) as well as time dependence (parallel progress of σ). The integrability of the generalized Schroedinger equation is then proved. As we transform to Heisenberg representation the electron wave function ψ loses its spinor character and the transverse photon field its tensor character, but by adding the coulomb field we restore the tensor character of the electromagnetic field. The gauge-independent quantum electrodynamics of Pauli's Handbuch article is a special form of the result thus obtained for the particular case that the number of electrons is known and finite. Our theory has a more general form allowing use of positon (hole) theory. (auth)

745

SOME NOTES ON MULTIPLE-BOSON PROCESSES. Roy J. Glauber. Phys. Rev. 84, 395-400(1951) Nov. 1.

Methods of calculation with nonlinear functions of quantized boson fields are developed during the discussion of two problems involving multiple-boson processes. In the first of these a simple treatment is given of the multiple radiation of photons by classical current distributions, a special case of which, in effect, is the infrared catastrophe. In the second illustration, generalizations of the scalar and pseudoscalar meson theories are considered in which the interaction hamiltonian depends exponentially on the meson field. In the pseudoscalar case such hamiltonians are closely related to the familiar form of pseudovector coupling. Assuming the over-all coupling of the nucleon and meson fields to be weak, calculations are made of the nuclear forces, and of the multiple production of mesons in meson-nucleon and in nucleon-nucleon collisions. In the latter events statistical independence of meson emissions is found to prevail. (auth)

746

DIVERGENT INTEGRALS IN RENORMALIZABLE FIELD THEORIES. Abdus Salam. Phys. Rev. 84, 426-31(1951) Nov. 1.

The proofs of the renormalization of the theories of scalar and pseudoscalar mesons in scalar interaction with nucleons and with the electromagnetic field, given previously by the author, (Phys. Rev. 82, 217(1951); NSA 5-4635), depended on a certain subtraction procedure. A general proof is here given that this subtraction procedure, when applied to a divergent integral in the S matrix of a renormalizable field theory, does, in fact, lead to an absolutely convergent, covariant, and unique remainder. (auth)

747

ON THE RELATIVISTIC PSEUDOSCALAR MESON THEORY OF THE DEUTERON. Maurice M. Levy. Phys. Rev. 84, 441-7(1951) Nov. 1.

The existence of stationary states of the neutron-proton system is discussed on the basis of a two-particle Dirac equation, including a retarded pseudoscalar interaction. This interaction (in which the possibility of creation of nucleons pairs is disregarded) is treated according to two different models: in the first one, the negative energy states of each nucleon are supposed to be filled, and the interaction is limited to transitions between positive energy states only; in the second model, which is the generalization of the "one-particle" theory, the negative energy states are considered as empty. It is shown that, in both cases, no stable stationary state exists with such an interaction. (auth)

748

EFFECT OF NUCLEON RECOIL ON NUCLEAR FORCES. Gentaro Araki. Progress Theoret. Phys. (Japan) 6, 379-393) (1951) May-June.

The correction due to the nucleon recoil on nuclear forces is discussed according to the scalar and the pseudoscalar meson theory. The correction entirely changes the apparent form of two-nucleon interaction in case of pseudoscalar theory. The singularity of the interaction becomes stronger in this case. However, the nonrelativistic limit is the same as the well-known potential. The nonadiabatic correction includes the typical spin-orbit interaction in case of scalar theory. The distinction of the present results from those which were obtained by other authors is discussed. (auth)

749

FUNDAMENTALS OF QUANTUM MECHANICS. Enrico Persico, tr. by Georges M. Temmer. New York, Prentice-Hall, Inc., 1950. 484p.

The primary objective of the author is a thorough explanation of the epistemological foundations of quantum mechanics for the beginning student. Following the historical development and wave mechanics, the general methods of quantum mechanics are given, introducing the concept of Hilbert space, operators, matrices, matrix methods, and perturbation theory. A more complete review appears in Am. J. Phys. 19, 478-9(1951) Nov.

750

ON THE MESON CLOUD AROUND THE NUCLEONS. H. Umezawa, Y. Takahashi, and S. Kamefuchi. Progres Theoret. Phys. (Japan) 6, 426-7(1951) May.

The properties of the meson cloud around a nucleon system are briefly investigated. The meson cloud is described by the function $U(x,\sigma)$ which satisfies the homogeneous equation of the free-meson field and coincides at the world point x/σ on the space-like surface σ with the field operator $U(x)$ in Heisenberg representation (Phys. Rev. 79, 972(1950)).

751

ON THE QUANTUM THEORY OF RECIPROCAL FIELDS AND THE CORRESPONDENCE PRINCIPLE. J. Rayski. Proc. Phys. Soc. (London) 64A, 957-68(1951) Nov.

A method of quantization of nonlocal fields whose interaction is expressible by means of integral equations is given. The S-matrix is constructed by Yang's method. The nonlocal field theory is free of the usual convergence difficulties. It is possible to satisfy generally either the postulate of reciprocity or the postulate of correspondence, but it seems impossible to satisfy both principles simultaneously. (auth)

752

ON THE SOLUTION OF WAVE EQUATIONS OF SPIN-½ PARTICLES INTERACTING WITH A CENTRAL PSEUDOSCALAR FIELD. Gérald Petiau. J. phys. radium 12, 810-16 (1951) Oct. (In French)

The wave functions for a spin-½ particle under the action of a pseudoscalar central potential are represented by combinations of polar and spherical functions, the differential system determining the polar functions is established, and solutions are given for certain particular cases, such as a constant pseudoscalar field and a pseudoscalar field decreasing as $1/r$, alone or in combination with electrostatic or scalar fields.

753

INVESTIGATION INTO THE HIGHER MOMENTS OF A NUCLEON CASCADE. L. Janossy and H. Messel. Proc. Roy. Irish Acad. 54A, 245-62(1951) May.

The fluctuation of a nucleon cascade in homogeneous nuclear matter was considered by Messel (Proc. Roy. Irish Acad. 54A, 125(1951)). Analytical expressions for the average numbers and the mean square deviation were given, as well as numerical results which showed that the mean square deviation in the case of a nucleon cascade in homogeneous nuclear matter was very similar to that found for the electron-photon cascade (Proc. Phys. Soc. (London) 63A, 1101(1950)). The procedure is generalized so as to obtain moments of a cascade which develops not in a single nucleus but in several nuclei. The problem of the traversal through a single nucleus is considered for the analysis of stars in emulsions. The problem of a finite absorber is also considered for the interpretation of counter or cloud-chamber experiments and for the theory of the development of large nucleon showers in the air.

754

ON THE QUANTUM THEORY OF THE MANY-ELECTRON PROBLEM IN SOLIDS. H. Volz and H. Haken. Z. physik. Chem. 198, No. ¼, 61-74(1951) Oct. (In German)

The Schroedinger equation of the interaction of many electrons in a periodic potential field has been investigated. Solutions of the form $\psi_K = e^{iKX} \cdot u_K(X,\xi_{iK})$, where u is a periodic function of the lattice constant in the center-of-mass coordinate X, depend on the relative coordinates ξ_{iK} of the electrons. The wave number K is given by $dK/dt = neF/\hbar$. The requirement of periodicity of the solution in each single coordinate leads to the possibility of writing a wave function for any arbitrary expanded crystal.

TRACER APPLICATIONS

755

DATING OF RELICS BY RADIOCARBON ANALYSIS. H. R. Crane. Nucleonics 9, No. 6, 16-23(1951) Dec.

The C^{14} method of dating relics is discussed and a specially designed G-M tube is described in which the carbon sample is coated within the cathode sleeve. Background counts are reduced to ~24/day/cm² of sample. Techniques of purifying, spreading, and counting the carbon are briefly described.

AUTHOR INDEX

For each reference the digit preceding the dash is the volume number and digits after the dash are the abstract number.

KERLIND C G
6- 596
ZENBERG FAY
6- 536
BERT PHILIPPE
6- 549
BRIGHT CHARLES H
6- 538
EXANDER B H
6- 603
LEN S
6- 618
ES LAB
6- 539 6- 558 6- 559
6- 560 6- 561 6- 562
6- 563 6- 573 6- 735
DERSON WENDELL L
6- 517
GER H O
6- 521
THONY D S
6- 532
AKI GENTARO
6- 748
GONNE NATIONAL LAB
6- 500 6- 501 6- 502
6- 506 6- 520 6- 526
6- 556 6- 568 6- 625
6- 640 6- 679 6- 698
MOUR RESEARCH
FOUNDATION
6- 591 6- 604
NSTEIN H R V
6- 571
OMIC ENERGY PROJECT
UNIV OF CALIF
6- 508
OMIC ENERGY PROJECT
UNIV OF ROCHESTER
6- 509 6- 510 6- 516
6- 528 6- 657
OMIC ENERGY RESEARCH
ESTABLISHMENT HARWELL
BERKS ENGLAND
6- 514 6- 544 6- 545
6- 639 6- 699
ERBACH B L
6- 595 6- 598 6- 618

CON G E
6- 721
ER W H
6- 596
INBRIDGE KENNETH T
6- 734
IR JOE KEAGY
6- 646 6- 647
KER H DEAN
6- 627
KER W H
6- 645
KER WILLIAM B
6- 647
KISH R
6- 600
LLUFFI R W
6- 603
RKAS WALTER H
6- 656
RTON J C
6- 614
SU D
6- 729
AUGE R
6- 696
LINFANTE FREDERIK J
6- 744
LL P R JR
6- 533
NDICH AARON
6- 566
NSEY FRANK N
6- 617
NSON A A
6- 531
NTLEY RONALD
6- 571
BERLIN T H
6- 688
BERNARDINI G
6- 672
BERNAS RENE
6- 636
BIRGE ANN C
6- 737
BISWAS S
6- 611
BLAIR HENRY A
6- 509 6- 510 6- 516
6- 657
BLAU M
6- 642
BLEARS J
6- 583 6- 585
BOLEY FORREST I
6- 735
BOLGIANO P
6- 688
BONFIGLIOLI GUIDO
6- 668
BONILLA C F
6- 579
BOWEN VAUGHAN T
6- 503
BRADLEY L C
6- 743
BRADY E L
6- 731
BRANSDEN B H
6- 720
BRANYAN C E
6- 739
BRAUNER A R
6- 665
BREIT G
6- 724
BRETON D
6- 697
BRIX PETER
6- 693
BRODA E
6- 663
BROOKHAVEN NATIONAL LAB
6- 492 6- 503 6- 507
6- 546 6- 551 6- 572
6- 626 6- 641 6- 642
6- 733 6- 734
BROWNELL GORDON L
6- 654
BRUES AUSTIN M
6- 500 6- 501 6- 506
6- 520 6- 526 6- 568
6- 625 6- 640
BRYANT L W
6- 675
BUCKALOO G W
6- 659
BUMILLER H
6- 522
BURBANK ROBINSON D
6- 617
BURKART M W
6- 600
BUSCH J S
6- 579
BUTLER T A
6- 559
BUYLE-BODIN MAURICE
6- 692

CANDLER C
6- 684
CARBIDE AND CARBON
CHEMICALS CO K-25
6- 617
CARNEGIE INST OF TECH
6- 597
CARON MICHEL
6- 549
CARSON S F
6- 532
CASE INST OF TECH
6- 680
CENTRAL AEROSOL LABS
COLUMBIA UNIV
6- 609
CHALMERS T A
6- 667
CHANG L C
6- 600
CHAUDRON GEORGES
6- 549
CHEBINIAK P
6- 592
CHENOUARD J
6- 547
CHILDS W J
6- 739
CHU H T
6- 579
CLIFFORD ALAN F
6- 552
COBAS AMADOR
6- 510
COBB JOSEPH R
6- 588
COBBLE JAMES W
6- 643
COCKCROFT J D
6- 514
COGAN DAVID G
6- 505
COHEN MORRIS
6- 594 6- 595 6- 598
6- 618
COHEN S G
6- 678
COLLEGE OF SCIENCES AND
ARTS STATE COLL OF
WASH
6- 535
COLLI LAURA
6- 558
COLLINGS W DOYNE
6- 529
COLNER WILLIAM H
6- 604
COLUMBIA UNIV
6- 489 6- 490 6- 579
6- 600 6- 627 6- 700
COMINGS E W
6- 575
COMMISSARIAT A L ENERGIE
ATOMIQUE
6- 547
CONARD G P
6- 618
CONNECTICUT AGRICULTURAL
EXPERIMENT STATION
6- 530
COOKE W DONALD
6- 574
COOPEY R W
6- 513
CORK J M
6- 739
CORROSION LAB
MASS INST OF TECH
6- 588
CORSON DALE R
6- 661
CORYELL C D
6- 731
COULING L
6- 601
CRANE H R
6- 755
CUEILLERON JEAN
6- 607

DARBY J F
6- 611
DARMOIS EUGENE
6- 541
DAUTREPPE DANIEL
6- 692
DAVIES W T
6- 723

DAWSON M H
6- 603
DERGE GERHARD
6- 599
DEUTSCH MARTIN
6- 681
DEVAY J E
6- 499
DIMOND A E
6- 530
DIRAC P A M
6- 621
DODGEN H W
6- 535
DRICKAMER H G
6- 537 6- 575
DUCRET L P
6- 542
DUDLEY HORACE C
6- 494 6- 527
DUKE FREDERICK R
6- 573
DULIT EVERETT
6- 681
DUNBAR D N F
6- 710

EBNOTHER A
6- 570
EDELMANN ABRAHAM
6- 507
EDLUND M C
6- 694
EIMER LOIS
6- 572
EISENSTEIN JULIAN
6- 608
EL-BEDEWI F A
6- 708
ELIASSEN ROLF
6- 515
ELVING PHILIP J
6- 538
ERTAUD A
6- 696 6- 597
EYRING HENRY
6- 498

FACCHINI UGO
6- 658
FAUQUEZ H
6- 696
FEITELBERG SERGEI
6- 519
FELDSTEIN O
6- 663
FINEMAN PHILLIP
6- 518
FLANAGAN W E
6- 598
FLANNAGAN R
6- 601
FLEISCHMANN R
6- 712
FLINN P A
6- 598
FOPIANO P
6- 618
FOSTER J W
6- 532
FRANCIS HOWARD T
6- 604
FRANCK J
6- 732
FRANKLIN E
6- 590
FRIEDMAN LEWIS
6- 551
FURMAN N HOWELL
6- 574

GATTI EMILIO
6- 658
GENDRON PIERRE R
6- 664
GEOLOGICAL SURVEY
6- 589
GEST HOWARD
6- 546
GHIORSO ALBERT
6- 736
GIBBS MARTIN
6- 546
GIBSON M
6- 544 6- 545
GILBERT W S
6- 701 6- 702
GILES PETER C
6- 656
GIMENEZ C
6- 587
GINZBURG L I
6- 581
GLAUBER ROY J
6- 745
GOFF JOHN L
6- 505
GOLDBLITH S A
6- 511
GOLDHABER M
6- 734
GOLDMAN MORTON I
6- 515
GOLDSTEIN LOUIS
6- 726
GORDON SHEFFIELD
6- 556
GOULD R GORDON
6- 565
GOWARD F K
6- 699 6- 709
GRAVES ELIZABETH
6- 505
GRAVESON ROBERT T
6- 628
GREENBERG D H
6- 700
GREENING J R
6- 730
GROSSKINSKY OTTO ALFRED
6- 569
GUERON J
6- 547

HADLEY JAMES WARREN
6- 716
HAEFNER RICHARD R
6- 691
HAKEN H
6- 754
HALES R W
6- 670
HALL ROBERT H
6- 528
HALL W H
6- 605 6- 606
HALPERN J
6- 706
HAMERMESH MORTON
6- 679
HAMILTON J G
6- 496
HANFORD WORKS
6- 513
HARRINGTON H
6- 659
HART E J
6- 556
HASZELDINE R N
6- 553
HAUGSNES J
6- 644
HAYES S
6- 601
HAYNES C W
6- 601
HENLEY ERNEST J
6- 660
HENRY KATHERINE E
6- 494
HEWSON E WENDELL
6- 676
HILDEBRAND R H
6- 655 6- 670
HILL D L
6- 698
HILL E L
6- 637
HILLIARD J
6- 598
HIRST F
6- 710 6- 711
HOLMES D K
6- 695
HOPPER V D
6- 611
HORNYAK W F
6- 641
HUBERT P
6- 741
HUDSWELL F
6- 639

ILLINOIS INST OF TECH
6- 552
ILLINOIS UNIV
6- 537 6- 543 6- 575
INTRATER J
6- 600

JAKOBSON MARK J
6- 671
JAMES HUBERT M
6- 557
JAMES J C
6- 564
JAMES RALPH A
6- 736
JANOSSY LEONIE
6- 616 6- 753
JASTROW R
6- 686
JEFFERSON W E
6- 532
JOHNSON H R
6- 548
JOHNSON M H
6- 622
JOHNSTON REED H
6- 555
JOYET GUSTAVE
6- 512

KAMEFUCHI S
6- 674 6- 750
KARP IRA L
6- 687
KARPLUS ROBERT
6- 690
KATO TOSIO
6- 719
KATSH SEYMOUR
6- 507
KAUFMAN WARREN J
6- 515
KIKUCHI SEISHI
6- 703
KINGSBURY S A
6- 662
KISIELESKI W E
6- 625
KISSINGER CHARLES W
6- 612
KIVALO PEKKA
6- 543
KLEIN ABRAHAM
6- 690
KLING H P
6- 603
KNABLE N
6- 655 6- 670
KNOLLS ATOMIC POWER LA
6- 592
KOHN WALTER
6- 727
KUHN H
6- 743
KUNDU D N
6- 705
KWAL BERNARD
6- 722

LABEYRIE JACQUES
6- 587 6- 666
LABORATORY FOR NUCLEAR
SCIENCE AND
ENGINEERING MASS INS
OF TECH
6- 654
LAFOUCRIERE J
6- 633
LAITINEN H A
6- 543
LALLEMANT CLAUDE
6- 666
LA MER VICTOR K
6- 609
LARK HOROVITZ KARL
6- 557
LAVIK P S
6- 659
LAWRENCE J H
6- 497
LEBLANC J M
6- 739
LEITH C E
6- 655
LEPSIUS RICHARD
6- 685
LEVINGER J S
6- 728
LEVY F
6- 672
LEVY HENRI A
6- 619
LEVY MAURICE M
6- 747
LIEBERMAN D S
6- 600
LINEIKIN P S
6- 623
LIPPS F
6- 688

AUTHOR INDEX

IPSCOMB WILLIAM N
6- 550
OCKHART HELEN S
6- 654
OMONT JOHN S
6- 744
ORING B M
6- 596
ORRIS S G
6- 595
OS ALAMOS SCIENTIFIC LAB
6- 505 6- 593
OUVIERE L J
6- 527
UCKE CHARLES E
6- 489 6- 490
UMRY RUFUS
6- 498 6- 540

CCUSKER C B A
6- 613
CDERMID W L
6- 638 6- 648 6- 649
6- 650 6- 651
ACHLIN E S
6- 594
CKINNEY D S
6- 597
CPHERSON D J
6- 591
ADANSKY LEON
6- 688 6- 689
ADDEN ROBERT E
6- 565
AGER L
6- 618
AIENSCHEIN F C
6- 647
ANN A K
6- 706
ARKAKIS P C
6- 511
ARTIN D W
6- 739
ASSACHUSETTS INST OF TECH
6- 594 6- 595 6- 598
6- 618 6- 676
EDALIA A I
6- 572
EHL ROBERT F
6- 599
ESSEL HARRY
6- 616 6- 753
ETALLURGICAL LABS SYLVANIA ELECTRIC PRODUCTS INC
6- 602 6- 603
ETALLURGICAL LAB UNIV OF CHICAGO
6- 732
ETALLURGICAL PROJECT UNIV OF CHICAGO
6- 731
ETALS RESEARCH LAB CARNEGIE INST OF TECH
6- 599 6- 601
ICHAELSON HERBERT B
6- 602
ICHIGAN STATE COLL
6- 529
IDDLETON R
6- 708
ILHAUD M
6- 524
ILLER ARTHUR
6- 660
ILLER CARL F
6- 560
ILLER J M
6- 700
ILNER C J
6- 584
INNESOTA UNIV
6- 499
ISRA B
6- 579
OSHINSKY MARCOS
6- 682 6- 683
OUND LAB
6- 645
OYER B J
6- 670
UNN JOHN I
6- 494
URRAY MARVIN
6- 529

AIRN J S
6- 639

NAKAMURA SEITARO
6- 740
NATIONAL PHYSICAL LAB GREAT BRITAIN
6- 675
NAVAL MEDICAL RESEARCH INST BETHESDA
6- 494 6- 527
NAVAL RESEARCH LAB
6- 596
NELSON R A
6- 589
NEPA DIV
6- 578 6- 546 6- 647
NESBITT JOHN B
6- 515
NEVIN T E
6- 613
NEW YORK OPERATIONS OFFICE
6- 628
NEW YORK UNIV
6- 653 6- 677
NEWTON GENE B
6- 629
NORDMAN CHRISTER E
6- 550
NORTHWESTERN UNIV
6- 644

OAK RIDGE NATIONAL LAB
6- 533 6- 577 6- 643
OAK RIDGE NATIONAL LAB Y-12 AREA
6- 694 6- 695
ORTH DONALD
6- 736
OUELLET C
6- 531

PANOFSKY H A
6- 677
PARKER J R
6- 638 6- 648 6- 649
6- 650 6- 651 6- 652
PARLIN RANSOM B
6- 620
PARTRIDGE WILLIAM S
6- 620
PASCAUD CLAUDE
6- 607
PEACOCK J M
6- 564
PEIRSON D H
6- 590
PENNSYLVANIA STATE COLL
6- 538
PEPKOWITZ L P
6- 592
PERLOW GILBERT J
6- 612
PERSICO ENRICO
6- 749
PETERSON S W
6- 619
PETIAU GERALD
6- 752
PHARES E F
6- 532
PHILLIPS G
6- 576
POCHAPSKY T E
6- 580
POOL M L
6- 705
PORTER PAUL EDWARD
6- 558 6- 562 6- 563
POWELL J E
6- 561
PRANATIS A
6- 601
PRESBYTERIAN HOSPITAL CHICAGO
6- 565
PROCTOR B E
6- 511
PUERTO RICO UNIV
6- 610

QUERIDO A
6- 523

RADIATION LAB UNIV OF CALIF
6- 495 6- 496 6- 497
6- 521 6- 531 6- 629
6- 655 6- 656 6- 669
6- 670 6- 671 6- 686
6- 687 6- 701 6- 702
6- 703 6- 715 6- 716
6- 717 6- 718 6- 736
6- 737

RADIO CORP OF AMERICA
6- 638
RAIEVSKI V
6- 697
RAMSKILL EUGENE A
6- 517
RAYSKI J
6- 751
RCA VICTOR DIV RADIO CORP OF AMERICA
6- 648 6- 649 6- 650
6- 651 6- 652
READ T A
6- 600
REIFFEL L
6- 665
REILLEY CHARLES N
6- 574
REISNER J H
6- 638 6- 648 6- 651
RESEARCH LAB OF ELECTRONICS MASS INST OF TECH
6- 548 6- 713
RICHMAN CHAIM
6- 669
RICHTER ESTHER
6- 508
RIDDIFORD L
6- 586 6- 714
RILEY RICHARD F
6- 508
RINGO G R
6- 679
ROBERTS J E
6- 686
ROBERTS J H
6- 644
ROBINSON BEROL L
6- 689
RODGER WALTON A
6- 518
ROOT ROBERT E
6- 528
ROSE J W
6- 701 6- 702
ROSENTHAL ISADORE
6- 538
ROSI F D
6- 603
ROTH E
6- 547
ROTHMAN ALAN
6- 597
ROWELL J B
6- 499
RUCHHOFT C C
6- 519
RUDMAN P S
6- 598
RUNNER MERVIN E
6- 552

SALAM ABDUS
6- 746
SARROUY JEAN-LOUIS
6- 636
SAWYER B
6- 601
SCHIFF DAPHNE
6- 664
SCHMID H
6- 570
SCHMID K
6- 570
SCHOMAKER VERNER
6- 554
SCHRODINGER ERWIN
6- 615
SCHULZ ALVIN G
6- 671
SCHWARTZ M A
6- 578
SCHWINGER JULIAN
6- 690
SCOTT JAMES K
6- 528
SEDGWICK LABS OF SANITARY SCIENCE MASS INST OF TECH
6- 515
SEIGLE L L
6- 598
SEMMEL J W
6- 600
SHARP W N
6- 589
SHAW D F
6- 723
SHAW J C
6- 527

SHEEHAN WILLIAM F JR
6- 554
SHER R
6- 706
SHOOLERY J N
6- 554
SHPINEL V S
6- 742
SHULMAN R G
6- 554
SINCLAIR W K
6- 525
SINGER I A
6- 677
SLATER J C
6- 713 6- 733
SLOAN-KETTERING INST FOR CANCER RESEARCH
6- 566
SMITH J E
6- 642
SMITH LINCOLN G
6- 626
SMOLUCHOWSKI R
6- 601
SPEDDING F H
6- 558 6- 559 6- 560
6- 561 6- 562 6- 563
SPIKES JOHN D
6- 498 6- 534 6- 540
6- 567
STAIR W K
6- 577
STEAD F W
6- 589
STEADMAN LUVILLE T
6- 528
STECKELMACHER W
6- 582
STEEL W H
6- 630
STERN MARTIN O
6- 717
STEUDEL ANDREAS
6- 693
STODDARD A E
6- 739
STOKINGER HERBERT E
6- 528
STONE C A
6- 665
STRANDBERG M W P
6- 548
STRIPEIKA ALEX J
6- 629
STROUD CATHERINE A
6- 528
SVEC HARRY J
6- 573
SVIHLA G
6- 625

TAHMISIAN T N
6- 502
TAI C T
6- 708
TAIEB JOSEPH
6- 635
TAKAHASHI Y
6- 674 6- 750
TAKETANI MITUO
6- 738 6- 740
TAYLOR DENIS
6- 631
TECHNICAL INFORMATION SERVICE AEC
6- 491
TELEGDI VALENTINE L
6- 704
TEMMER GEORGES M
6- 749
TENNESSEE UNIV
6- 504
TERRALL J R
6- 713
THIRRING W
6- 673
THOMPSON T J
6- 718
TITTERTON E W
6- 707
TUNG L H
6- 537
TURKEVICH JOHN
6- 551
TURNER R W
6- 601

UEBERGANG R
6- 711
UHLIG HERBERT H
6- 588
UMEZAWA H
6- 674 6- 750
UMEZAWA MINORU
6- 740
UNDERWOOD E E
6- 598
UTAH UNIV
6- 498 6- 534 6- 540
6- 567 6- 620

VALLADAS G
6- 634
VALLANDER S V
6- 624
VAUTREY L
6- 696
VOIGT ADOLF F
6- 539
VOLZ H
6- 754

WABER JAMES T
6- 593
WABER SANTON
6- 593
WAGGONER PAUL E
6- 530
WAHL R
6- 632
WALSH P D
6- 556
WANG S J
6- 579
WARNER J C
6- 597
WASER P
6- 570
WATTENBERG ALEXANDER
6- 679
WEILL JACKY
6- 666
WESTERN RESERVE UNIV SCHOOL OF MEDICINE
6- 546
WEYGAND FRIEDRICH
6- 569
WHITE R STEPHEN
6- 671
WHITEHEAD MARIAN
6- 669
WILKINS J J
6- 699 6- 709
WILKINSON K L
6- 639
WILLIAMSON G K
6- 605 6- 606
WILSON ELIZABETH
6- 734
WISCONSIN UNIV
6- 536
WOLTERINK LESTER F
6- 529
WOUTERS L F
6- 715
WRIGHT J M
6- 558 6- 563

YAFFE RUTH POWERS
6- 539
YAMAGUCHI YOSHIO
6- 740
YANG C N
6- 725
YOST DON M
6- 554

ZAFFARANO D J
6- 735
ZARZYCKI GEORGES
6- 541
ZIRINSKY S
6- 600
ZWOLINSKI BRUNO J
6- 620

NUMERICAL INDEX OF REPORTS

Numerical Index of Official Atomic Energy Reports with Indications of Their Availability

This list in the individual issues of Volume 6 supplements the Numerical Index of Reports with Indications of Their Availability which appears in NSA, Volume 5, No. 24. As reports are in manuscript form when abstracted for NSA, there may be some delay before the reports will be available at the Depository Libraries. The notation NSA in the Availability column indicates the appearance of a report in its entirety in NSA.

Abbreviations used below are:

NSA - NUCLEAR SCIENCE ABSTRACTS
ADD - ABSTRACTS OF DECLASSIFIED DOCUMENTS the predecessor of NSA
NNES - National Nuclear Energy Series, published by the McGraw-Hill Book Company

Code designations are assigned as follows:

MDDC - To declassified reports released by the Manhattan Engineer District and by the Atomic Energy Commission before March 1, 1948
AECD - To declassified reports released by the Atomic Energy Commission after February 29, 1948 (appeared in April 15, Nuclear Science Abstracts)
AECU - To unclassified reports originating within the Atomic Energy Project. (Subsequent to AECU-871, this code is applied only to reports carrying no other recognized code designation.)

Other code designations below are assigned to unclassified reports by the originating installations

eport	Abstract	Availability
CD-3235	NSA 5-5842	Phys. Rev. 84, 862-3(1951)
3238	5-5686	$0.20
3241	5-5684	0.40
CU-1008	5-2073	0.10
1103	5-2112	Iowa State Coll. J. Sci. 24, 397-403(1950)
1106	5-1212	J. Immunol. 67, 15-20(1951)
1316	5-4066	Arch. Ind. Hyg. Occupational Med. 4, 65-73 (1951)
1341	5-4069	J. Immunol. 67, 21-33(1951)
1482	5-7036	Am. J. Clin. Path. 21, 489-91(1951)
1486	5-4360	Cancer Research 11, 845-50(1951)
1502	5-4869	Phys. Rev. 84, 731-6(1951)
1540	5-5399	Phys. Rev. 84, 703-9(1951)
1548	5-5251	J. Chem. Phys. 19, 1320-21(1951)
1567	5-4964	Cancer Research 11, 877-84(1951)
1580	5-5354	Phys. Rev. 84, 775-8(1951)
1634	5-6352	Phys. Rev. 84, 779-85(1951)
1637	5-6294	Phys. Rev. 84, 824-9(1951)
1638	5-6310	Phys. Rev. 84, 852(1951)
1651	5-6604	New England J. Med. 245, 875-8(1951)
-WMM-661 ev.)	5-4591	Phys. Rev. 84, 785-6(1951)

Report	Abstract	Availability
HW-20999	NSA 5-6082	$0.10
ISC-158	5-7302	0.15
163	5-7184	0.25
165	5-7012	0.10
LA-981	5-5974	Phys. Rev. 84, 695-9(1951)
NP-3400	5-7068	Trans. Am. Soc. Mech. Engrs. 73, 803-9 (1951)
NYO-1525	5-526	Heating and Ventilating 48, 79-82(1951)
1544	5-3014	J. Morphol. 89, 323-7(1951)
1545	5-4669	J. Morphol. 89, 327-35(1951)
ORNL-1009	5-6047	J. Bact. 61, 389-94(1951)
1020	5-5299	$0.10
UCLA-83	4-5662	Arch. Biochem. 30, 333-40(1951)
93	5-286	J. Cellular Comp. Physiol. 38, 69-82(1951)
94	5-287	J. Cellular Comp. Physiol. 38, 51-68(1951)
UCRL-1077	5-2584	Phys. Rev. 84, 671-83(1951)
1400	5-7252	$0.15
1433	5-6353	Phys. Rev. 84, 857-8(1951)

NEW NUCLEAR DATA

Summary of New Nuclear Data on Half Lives, Radiations, Relative Isotopic Abundances, Nuclear Moments, Neutron Cross Sections, Reaction Energies, and Masses

Prepared by National Bureau of Standards Nuclear Data Group with the Assistance of Readers

For a list of the abbreviations used in this section, see NSA, Vol. 6, No. 1, page "SUPPLEMENT 1".

${}_{2}\mathrm{He}_{2}^{4}$	Level $H^3(p,\gamma)$ 20.4 ± 0.2 s	R. S. Rochlin, Phys. Rev. 84, 165(1951).
Li	σ_t(1.3 to 3.4 Mev) graph	C. K. Bockelman et al., Phys. Rev. 84, 69(1951).
${}_{3}\mathrm{Li}_{4}^{7}$	$Li^6(d,p\gamma)$ $p\gamma(\theta)$ indicates I = ½ for 0.477 level	J. O. Newton, Proc. Phys. Soc. (London) 64A, 938(1951).
${}_{3}\mathrm{Li}_{5}^{8}$	Level 2.2 $Li^7(n,n)$ Γ = 0.040 J = 3	P. H. Stelson and W. M. Preston, Phys. Rev. 84, 162(1951).
Be	σ_t(1.3 to 3.4 Mev) graph Peak: 2.73	C. K. Bockelman et al., Phys. Rev. 84, 69(1951).
${}_{4}\mathrm{Be}_{3}^{7}$	K(0.479 level)/ K(ground) = 0.123 from data of 49T6	J. M. Dickson and T. C. Randle, Proc. Phys. Soc. (London) 64A, 902(1951).
${}_{4}\mathrm{Be}_{4}^{8}$	Level $Li^7(p,n)Be^7$ 18.90?	T. W. Bonner and J. W. Butler, Phys. Rev. 83, 1091(1951).
B	σ_t(0.9 to 3.4 Mev) graph Peaks: 1.28, 1.78, 2.45, 2.58	C. K. Bockelman et al., Phys. Rev. 84, 69(1951). See also B^{12}.
${}_{5}\mathrm{B}_{5}^{10}$	Levels Be(d,n) 5.110, 5.163, 5.924	T. W. Bonner and J. W. Butler, Phys. Rev. 83, 1091(1951).
${}_{5}\mathrm{B}_{5}^{10}$	σ_t(0 to 3.4 Mev) graph Maxima: 1.8, 2.8	C. K. Bockelman et al., Phys. Rev. 84, 69(1951).
${}_{5}\mathrm{B}_{5}^{10}$	$\sigma_{(n,\alpha)}$ E_m = 0.3 to 2.5 graphs	B. Petree et al., Phys. Rev. 83, 1148(1951).
${}_{5}\mathrm{B}_{6}^{11}$	Levels $B^{10}(d,p)$ 4.50, 6.4* pair s 6.7, 8.88	J. G. Rutherglen et al., Proc. Phys. Soc. (London) 64A, 906 906(1951). *In C^{11}?

${}_{5}\mathrm{B}_{7}^{12}$	$B^{11}(n,\gamma)$ Levels Γ(kev) J 4.46 130 3 4.92 65 1 5.53 120 2 5.63 60 3	C. K. Bockelman et al., Phys. Rev. 84, 69(1951).
C	σ_t(1.3 to 3.4 Mev) graph Peaks: 2.08, 2.95	C. K. Bockelman et al., Phys. Rev. 84, 69(1951).
${}_{6}\mathrm{C}_{5}^{11}$	τ 20.0^m	J. M. Dickson and T. C. Randle, Proc. Phys. Soc. (London) 64A, 902(1951).
${}_{6}\mathrm{C}_{6}^{12}$	Level $B^{11}(d,n)$ 4.44 pair s	J. G. Rutherglen et al., Proc. Phys. Soc. (London) 64A, 906(1951).
${}_{6}\mathrm{C}_{7}^{13}$	Level $C^{12}(d,p)$ 3.05 pair s	L. M. Baggett and S. J. Bame, Jr., Phys. Rev. 84, 154(1951).
${}_{6}\mathrm{C}_{7}^{13}$	$C^{12}(n,\gamma)$ Levels Γ(kev) J 6.80 ≤11 ≥3/2 7.60 120 3/2	C. K. Bockelman et al., Phys. Rev. 84, 69(1951).
${}_{6}\mathrm{C}_{8}^{14}$	Level $C^{13}(d,p)$ 6.10 pair s	L. M. Baggett and S. J. Bame, Jr., Phys. Rev. 84, 154(1951).
${}_{7}\mathrm{N}_{7}^{14}$	Levels $C^{13}(d,n)$ 3.40 pair s 5.04	L. M. Baggett and S. J. Bame, Jr., Phys. Rev. 84, 154(1951).
${}_{7}\mathrm{N}_{8}^{15}$	Levels $C^{14}(p,n)N^{14}$ 11.29, 11.43, 11.76, 11.88, 11.96, 12.10, 12.15, 12.33, 12.49	W. D. Roseborough et al., Phys. Rev. 83, 1133(1951).
O	σ_t(1.2 to 3.5 Mev) graph Peaks: 1.32, 1.66, 1.84, 1.91, 2.37	C. K. Bockelman et al., Phys. Rev. 84, 69(1951).

${}_{8}\mathrm{O}^{17}_{9}$	$O^{16}(n,\gamma)$ Levels Γ(kev) J 5.69 ≤ 7 $\geq 3/2$ 5.86 ≤ 10 $\geq 3/2$ 5.93 30 1/2 6.36 120 1/2	C. K. Bockelman et al., Phys. Rev. 84, 69(1951).
${}_{9}\mathrm{F}^{17}_{8}$	$O^{16}(p,p \text{ or } \gamma)$ Levels J 3.11 $s_{1/2}$ 3.88 $f_{7/2}$ 4.36 $d_{3/2}$ 4.73 $p_{3/2}$	R. A. Laubenstein et al., Phys. Rev. 84, 12, and 18(1951).
Al	σ_t graphs as function of temp(Al) and E_n	J. M. Cassels, Proc. Roy. Soc. (London) 208A, 527(1951).
${}_{14}\mathrm{Si}^{28}_{14}$	Levels $Al^{27}(p,\gamma)$ 7.6, 10.46, 12.12 } pair s	J. G. Rutherglen et al., Proc. Phys. Soc. (London) 64A, 906(1951).
${}_{14}\mathrm{Si}^{30}_{16}$	Levels $Al(\alpha,p)$ 2.3, 3.6, 4.9 from $p\gamma$	H. H. Landon, Phys. Rev. 83, 1081(1951).
${}_{17}\mathrm{Cl}^{35}_{18}$	$q(Cl^{35})/q(Cl^{37}) = 1.2688$	H. G. Dehmelt and H. Krüger, Z. Physik 129, 401(1951).
${}_{17}\mathrm{Cl}^{37}_{20}$	q	See Cl^{35}, Dehmelt.
${}_{23}\mathrm{V}^{51}_{28}$	I 7/2 para	B. Bleaney et al., Proc. Phys. Soc. (London) 64A, 601(1951).
${}_{26}\mathrm{Fe}^{55}_{29}$	$\sigma_t(0.003 \text{ ev})$ 7.8 $\sigma_{coh}(0.003 \text{ ev})$ 6.0	W. W. Havens, Jr., and L. J. Rainwater, Phys. Rev. 83, 1123(1951).
${}_{26}\mathrm{Fe}^{55}_{29}$	τ 3.0^y pc	R. P. Schuman and A. Camilli, Phys. Rev. 84, 158(1951).
${}_{26}\mathrm{Fe}^{59}_{33}$	τ 45.1^d pc	R. P. Schuman and A. Camilli, Phys. Rev. 84, 158(1951).
Co	Resonances (ev) E_0 σ_0 Γ 126 9100* 5.0* 5000	W. W. Havens, Jr., and L. J. Rainwater, Phys. Rev. 83, 1123(1951). *Assuming $\gamma_n \gg \Gamma_\gamma$.
${}_{27}\mathrm{Co}^{55}_{28}$	$\beta\gamma(\theta)$ = const.	D. T. Stevenson and M. Deutsch, Phys. Rev. 83, 1202(1951).
${}_{27}\mathrm{Co}^{56}_{29}$	$\beta\gamma(\theta)$ = const.	D. T. Stevenson and M. Deutsch, Phys. Rev. 83, 1202(1951).
${}_{29}\mathrm{Cu}^{64}_{35}$	τ 12.74^h pc	R. P. Schuman and A. Camilli, Phys. Rev. 84, 158(1951).
${}_{29}\mathrm{Cu}^{64}_{35}$	K Auger $e^-/\beta^+ = 1.2$	E. Plassman and F. R. Scott, Phys. Rev. 84, 156(1951).
${}_{29}\mathrm{Cu}^{66}_{37}$	τ 5.12^m pc	R. P. Schuman and A. Camilli, Phys. Rev. 84, 158(1951).
Zn	Resonances (ev) E_0 $\sigma_0\Gamma^2$ 520 6.9×10^4 1100 2.3×10^4 3800 2.5×10^6	W. W. Havens, Jr., and L. J. Rainwater, Phys. Rev. 83, 1123(1951).
${}_{30}\mathrm{Zn}^{65}_{35}$	K/β^+ 25 ± 10 cc for ground transition	J. K. Major, Compt. rend. 233, 947(1951).
${}_{33}\mathrm{As}^{76}_{43}$	γ 100* 0.555 9.5 0.648 25 1.210 1.6 1.410 5 2.06 } sl; pe^-, Cpt	P. Hubert, J. phys. radium 12, 823(1951). *Relative intensities of γ's from pe^-.
Br	Resonances (ev) E_0 σ_0 Γ 35.7 9000* 0.15* 54 6000* 0.15* 104 4700** 0.24** 136 4800* 0.45*	W. W. Havens, Jr., and L. J. Rainwater, Phys. Rev. 83, 1123(1951). *Assuming $\Gamma_n \approx \Gamma_\gamma$. **Assuming $\Gamma_n \approx 3\Gamma_\gamma$.
${}_{35}\mathrm{Br}^{79}_{44}$	$q(Br^{79})/q(Br^{81}) = 1.1970$	H. G. Dehmelt and H. Krüger, Z. Physik 129, 401(1951).
${}_{35}\mathrm{Br}^{81}_{46}$	q	See Br^{79}, Dehmelt.
Rb	No measurable amount of Kr found in old Rb ores. K/β^- <1/40,000.	E. K. Gerling and N. V. Baranovskaya, Doklady Akad. Nauk S.S.S.R. 76, 825(1951), in Guide to Russ. Sci. Period. Lit. 4, 203(1951).
${}_{37}\mathrm{Rb}^{86}_{49}$	τ 1.06^m γ 0.78 K x-rays?	A. Flammersfeld, Z. Naturforsch. 6a, 559(1951). Rb (slow and fast n).
${}_{37}\mathrm{Rb}^{87}_{50}$	τ 6.2×10^{10y} β^- 0.275 pc No ce^- or x-rays	S. C. Curran et al., Phys. Rev. 84, 151(1951).
${}_{43}\mathrm{Tc}^{99}_{56}$ 5.9^h	γ 0.139 $s\pi$;ce^- $K/L \sim 10$	N. Marty-Wollman, Ann. Phys., 6, 662(1951).
${}_{42}\mathrm{Mo}^{99}_{57}$	β^- 1.25 $s\pi$ γ ~20* 0.139 ~10 0.745 ~5 0.780 ~3 0.850] $s\pi$; pe^- Cpt	N. Marty-Wollman, Ann. Phys., 6, 662(1951). *Relative intensities of photons from pe^-. See also Tc^{99}.
${}_{51}\mathrm{Sb}^{124}_{73}$	$\beta\gamma(\theta)$ suggests $1 \xrightarrow{2.29\beta} 1 \xrightarrow{0.602\gamma} 0$ or $3 \longrightarrow 2 \longrightarrow 0$	D. T. Stevenson and M. Deutsch, Phys. Rev. 83, 1202(1951).

${}_{53}\mathrm{I}^{124}_{71}$	No (2.2 Mev β^+)γ coincidences			D. T. Stevenson and M. Deutsch, Phys. Rev. 83, 1202(1951).
${}_{58}\mathrm{Ce}^{144}_{86}$	τ	282^d	pc	R. P. Schuman and A. Camilli, Phys. Rev. 84, 158(1951).
${}_{61}\mathrm{Pm}^{147}_{86}$	τ	2.6^y	pc	R. P. Schuman and A. Camilli, Phys. Rev. 84, 158(1951).
${}_{79}\mathrm{Au}^{197}_{118}$	q	~+0.5	S	W. von Siemens, Naturwissenschaften 38, 455(1951).
${}_{79}\mathrm{Au}^{198}_{119}$	σ(th n,γ)3.3^d Au = 3.8×10^4			P. M. Sherk and R. D. Hill, Phys. Rev. 83, 1097(1951).
${}_{79}\mathrm{Au}^{199}_{120}$	β_1^- β_2^- β_3^-	22.5% 0.250 73.5% 0.300 4% 0.460	sπ	P. M. Sherk and R. D. Hill, Phys. Rev. 83, 1097(1951).
	γ	3.5% 0.050 77% 0.159 19% 0.209	sπ; ce$^-$, sl; pe$^-$	$\alpha_L = 6$ $\alpha_K = 0.19$; K/L = 0.61 $\alpha_K = 0.54$; K/L = 5.4
${}_{80}\mathrm{Hg}^{199}_{119}$	μ	0.56	S	E. W. Foster, Proc. Roy. Soc. (London) 208A, 367(1951).
${}_{82}\mathrm{Pb}^{207?}_{125}$	τ	0.82^s		J. Lascoux and G. Vendryes, Compt. rend. 233, 858, (1951).
${}_{83}\mathrm{Bi}^{212}_{129}$	α to 0.608 level 0.016% of α's			A. Rytz, Compt. rend. 233, 790(1951).
${}_{88}\mathrm{Ra}^{226}_{138}$	α	~93.3% (4.8) ~6.5% (4.6) ~0.2% 4.21		G. Bastin-Scoffier, Compt. rend. 233, 945(1951).
${}_{89}\mathrm{Ac}^{227}_{138}$	I	3/2	S	F. S. Tompkins et al., Phys. Rev. 84, 168(1951).
${}_{90}\mathrm{Th}^{228}_{128}$	$\alpha\gamma(\theta)$ indicates $0 \xrightarrow{\alpha} 2 \xrightarrow{\gamma} 0$ predominant			J. K. Beling et al., Phys. Rev. 84, 155(1951).
${}_{94}\mathrm{Pu}^{243}_{149}$	τ β^- γ	5.0^h 0.39 0.095 0.12	 s,a s,a s,a	S. G. Thompson et al., Phys. Rev. 84, 164(1951). $\mathrm{Pu}^{242}(n,\gamma)$.

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